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Municipal Sewage Treatment: Problems and Considerations

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OPTIMUM YIELD AND THE FCMA: UNEVEN DISTRIBUTION OF MANAGEMENT BURDEN

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INTRODUCTION

Until the establishment of the Fishery Conservation and Management Act of 1976 (FCMA)1, fish outside the United States' twelve mile fishery zone were, according to international law, common property and belonged to the nation or individual that caught them. This common property law was based on the concept that fish resources were so large that no amount of fishing would interfere with the right of others to catch fish. Modern technology, however, has created equipment that enabled foreign and domestic fishermen to over-fish the resource. A reduced domestic catch led coastal fishermen to support a bill that unilaterally extended the United States fisheries jurisdiction to 200 miles.

Before the FCMA, the distant water fleets of the United States and foreign nations took advantage of the common property status of fish and operated off the coasts of other nations. For example, the United States tuna fleet follows tuna into waters adjacent to many nations. The U.S. tuna fishermen were fearful of a U.S. unilateral extension to a 200 mile fishing zone triggering foreign extensions eliminating their traditional fishing grounds.

1The Fishery Conservation and Management Act of 1976 is known as the 200 Mile Bill, the 200 Mile Limit, the FCMA, and Public Law 94-265 (hereafter cited as the FCMA).

In order to reduce the objections of the tuna fleet, Congress decided to manage all fishing except highly migratory species, such as tuna. With this one political concession, the coastal fishermen were able to get Congress to pass a bill that gives priority fishing rights to U.S. fishermen on the basis of nationality.

Many domestic fishermen supported this bill because they believed that foreign fishing would be stopped and that the domestic fleet could then catch fish without interference or regulation. Congress had different ideas. It declared that fish --a renewable resource providing income for the economy, food for the nation, and recreation for sportsmen-- have been threatened through uncontrolled fishing. It felt that catches should be managed to promote the recovery of the stocks and full utilization of the underfished species2. Congress also observed that because both foreign and domestic fishing caused the problem, fisheries should be regulated on a domestic as well as international level3. Although the FCMA is not supposed to discriminate among domestic fishermen, there clearly is the possibility of discrimination when an unequal allocation of wealth

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2FCMA Sec.2 Findings, purposes and policy.

3FCMA Sec.2 Findings, purposes and policy. U.S., Committee on Commerce, A Legislative History of the Fishery Conservation and Management Act of 1976, p.363. p.370. (hereafter cited as Legislative History).

occurs. For example, the months of peak harvest for cod fish are different for each state in New England, so a cod fish closure has a greater economic impact on the state whose peak fishing coincides with the closure.

In the FCMA there are Seven National Standards including Standard Four which prohibits discrimination between residents of different states. Some of the potential management techniques cause the management burden to fall on one group of residents and not another. This burden may be discriminatory and prohibited by Standard Four or the regional councils should at least be aware that they are not treating all residents the same. Although Standard Four is legally no more important than the others, it is the topic of this thesis.

In order to discuss potential violations of "Standard Four" or the economic consequences of fisheries management on fishermen from different states it is necessary to understand six points: (1) which institutions manage the stocks of fish, (2) what objectives could be reached through management, (3) the optimum yield from a fishery, (4) the stock assessment methods, (5) the management techniques available, (6) and how discrimination could occur.

CHAPTER I. INSTITUTIONAL FRAMEWORK

This chapter deals with the local, state, and federal fisheries managers, and their activities in the fisheries zone set up by the FCMA. The three national departments that have a role in managing the fish are the Department of Commerce, the Department of Transportation, and the Department of State. The regional Councils, set up by the FCMA, function as an intermediate level between the federal and state governments. The regional Councils were set up by the FCMA because the problems of fishery management should be managed at a local level but no one state is large enough to encompass the entire stock of fish.

JURISDICTION

The jurisdictional breakdown, for fisheries purposes, of the waters adjacent to the United States coast consists of two bands of ocean which are controlled by either the respective state governments or the federal government. The Fishery Conservation Zone is measured 197 nautical miles seaward from the territorial sea. This band is supervised, in an executive sense, by the Department of Commerce. The territorial sea is measured from the closing lines which separate the internal waters from the

territorial sea, the low water mark, three nautical miles seaward and is controlled by the state governments. Because Congress foresaw that contradictory and damaging regulations could be adopted by the states in their respective three-mile zones, it made provisions for federal preemption of state regulations.4

REGIONAL COUNCILS

The FCMA set up eight regional management Councils that function as an intermediate level of government. The regional Councils include the Mid-Atlantic Council, the South-Atlantic Council, the Gulf Council, the Caribbean Council, the Pacific Council, the North Pacific Council, the Western Pacific Council, and the New England Council. The composition of the New England Council will serve as an example of the composition of the Councils in general.

The New England Council has seventeen voting members: the fisheries department head from each of the five states, the regional director of the National Marine Fisheries Service (NMFS, a part of the Department of Commerce), and eleven representatives appointed by the Secretary of Commerce from lists of qualified individuals

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4Three conditions are necessary before preemption can occur: (1) a management plan for the fishery conservation zone must be in effect, (2) the majority of the fishing must take place in the Fishery Conservation Zone, and (3) the action or inaction of a state must have had a substantial and adverse effect on the management plan.

submitted by each state governor. Non-voting members include representatives from the Coast Guard, the State Department, the Fish and Wildlife Service, and the Marine Fisheries Commission. Other regional Councils have different non-voting members specified.

The FCMA requires that the Secretary of Commerce appoint at least one of the eleven members at large from each state in the region.5 In the New England Council, the first appointments included four representatives from Massachusetts, three from Rhode Island, two from Maine, and the required one each from Connecticut and New Hampshire.

INDUSTRY REPRESENTATION

Of the eleven "qualified individuals" who were originally appointed to the New England Council, ten were industry representatives, and one was a university professor. It is not surprising that so many were industry related, because "the term 'qualified individual' means an individual who is knowledgeable or experienced with regard to the management, conservation, recreational

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5Ibid. Sec. 302. Regional fishery management Councils.

or commercial harvest, of the fish resources of the geographical area concerned."6 By definition, the members of the Council will be people who have had enough experience through their occupations to be considered a "qualified individual."

Industry representatives of the New England Council include processors, dealers, commercial fishermen, and recreational fishermen. It would be a mistake however, to conclude that all industry representatives have the same commercial interests and will vote as a block on all issues. Some of the original Council representatives have two or more constituent groups. For example, one member owns fishing vessels and processes fish while another is a dealer from a co-operative belonging to commercial

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6Ibid. Sec. 302 (b)(1)(C). Voting members.
The process adopted for selecting a "qualified individual" to serve on the Council reduces the possibility of a consumer representative. A consumer representative could oppose biological management techniques that the commercial interests may champion because the costs would be passed on to the consumer. The fishery biologist or economist could then provide neutral scientific evidence to resolve the conflict. Data supplied by an economist could help resolve the conflict between reducing costs for the consumer and keeping fishermen employed. The elimination of a cost-cutting technology always costs the consumer more money, even though it may help stabilize the brood stock of fish. A legally sanctioned regulatory body with only selected special interest groups represented has the potential for economic abuse of the consumer.

fishermen. The voting patterns will, therefore, skew management plans in the best interest of the industry group that has the greatist representation on the Council. The Council is intended to be a self balancing microcosm of the competing interests involved in fisheries.

COUNCIL RESPONSIBILITIES

The regional Councils have the task of developing a management plan for each specie of fish in their respective regions.7 "The regional Councils are designed to maintain a close relation with those at the most local level interested in and affected by fisheries management. The Secretary of Commerce is given authority under the bill to act as the 'executive.'"8 When the regional Councils began operations in 1977, there were disagreements about whether the regional Councils were advisory bodies for the Department of Commerce or separate legislative bodies. The National Marine Fisheries Service (NMFS) stated in the operations manual that "it is clear that the Councils have the primary role in development of fishery management plans and that their role extends beyond that of an advisory committee."9 However, some

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7Ibid. Sec. 302 (b)(1). Functions.

8Ibid. Sec. 304. Action by the Secretary.

members of the regional Councils feel that the Councils are still treated like advisory committees. This feeling is a result of the Councils forced reliance on NMFS data to establish the Optimum Yield (OY) and of the legislated power of the Secretary of Commerce to veto the Council plans.

Management plans are developed by following a specified sequence of information gathering and idea formation. The Councils must first determine the objectives to be met by the plan (explained later) and obtain a figure for the Maximum Sustainable Yield (MSY) based upon the best scientific information available.10 The NMFS in New England has the only scientificly collected information to establish the MSY, so the New England Council uses the NMFS information. If this information is biased, underestimating the stock of fish or the MSY, it may result in allocation problems when a smaller catch is divided among competing users.

The MSY for a particular species is modified into the Optimum Yield (OY) through Council meetings and public hearings by considering social, economic, and ecological

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9U.S. NMFS, Operations Manual; Regional Fisheries Management Council, June 11,1976, p1-5

10FCMA Sec. 301 (a)(2). National Standards for fisheries conservation and management.

factors. Next, the Council must estimate how much of the species the domestic fleet can take. The amount of fish that the domestic fleet cannot catch, not exceeding the OY, is the Total Allowable Level of Foreign Fishing (TALFF).11 Finally, the Council must allocate the domestic catch among competing fishermen by choosing management techniques that are consistent with the national standards.

DEPARTMENT OF COMMERCE RESPONSIBILITIES

On the national level the Department of Commerce (DOC) has the authority to approve the fishery management plans, promulgate implementing regulations, enforce these regulations, and determine the assessment of fines for violators.12 Because the fisheries management plans must be prepared according to national standards, the DOC must review fisheries management plans and veto them if they do not meet the following national standards contained in the FCMA:

> (a) In General.-Any fisheries management plan prepared, and any regulation promulgated to implement any such plan, pursuant to this title shall be consistent with the following national

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11Ibid. Sec. 201 (d). Total Allowable Level of Foreign Fishing.

12Ibid. Sec. 304. Action by Secretary.

standards for fisheries conservation and management:

(1) Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery.

(2) Conservation and management measures shall be based upon the best scientific information available.

(3) To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

(4) Conservation and management measures shall not discriminate between residents of different States. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be (A) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and (C) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.

(5) Conservation and management measures shall, where practicable, promote efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose.

(6) Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

(7) Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.13

On the basis of these seven national standards and the definition of Optimum Yield, the Secretary of Commerce

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13Ibid. Sec. 301. National Standards for fisheries conservation and management.

must, after public hearings and all other bureaucratic processes, either promulgate enabling regulations or send the management plan back to the Council for amendments.14 If the regional Council does not act within a reasonable time, the Secretary may prepare his own fisheries management plan.15 Also "if the Secretary finds that an emergency involving any fishery resources exists, he may promulgate emergency regulations..."16 The Secretary must also "carry out any fishery management plan or amendment approved or prepared by him, in accordance with the provisions of this Act (the FCMA)."17 The FCMA states that "the Secretary shall initiate and maintain a comprehensive program of fishery research..."18

The National Oceanic and Atmospheric Administration, a section of the Department of Commerce, has a component called the NMFS . The NMFS makes fish stock assessment, supplies Council support personnel, has a voting seat on the regional Council, and assists the Coast Guard in enforcing of the FCMA.

14Ibid. Sec. 304. Action by Secretary.

15Ibid. Sec. 304 (c). Preparation by the Secretary.

16Ibid. Sec. 305 (e). Emergency Actions.

17Ibid. Sec. 305 (g). Responsibility of the Secretary.

18Ibid. Sec. 304 (e). Fisheries research.

DEPARTMENT OF TRANSPORTATION RESPONSIBILITIES

The Coast Guard, a division of the Department of Transportation, is the primary enforcement division of the FCMA. The enforcement activities include surveillance, boarding, issuing of citations, and patrolling the zone for domestic as well as foreign fleets. The Coast Guard also has non-voting representatives on the regional Councils to advise on enforcement matters and keep up to date on pending regulations.

DEPARTMENT OF STATE RESPONSIBILITIES

The Department of State negotiates with foreign governments to establish Governing International Fisheries Agreements (GIFA's). These GIFA's include an acknowledgment of the United States' right to manage the fish inside the 200 mile fishing zone, the right of a United States official to inspect a fishing vessel at sea and seize it for violations, the right to reciprocal fisheries agreements, and the obligation to pay for enforcement costs.19

The Department of State also must distribute the Total Allowable Level of Foreign Fishing on a yearly basis to the foreign nations that have signed GIFA's. "The total allowable level of foreign fishing, if any, with respect to any fishery subject to the exclusive fishery

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19Ibid. Sec. 201., Sec. 202., Sec. 204.

management authority of the United States, shall be that portion of the optimum yield of such fishery which will not be harvested by vessels of the United States...".20 In its allocation decisions the Department of State must consult with the Department of Commerce and consider the following items specified in the FCMA:

> (1) Whether, and to what extent, the fishing vessels of such nations have traditionally engaged in fishing such fishery;
> (2) Whether such nations have cooperated with the United States in, and made substantial contributions to, fishery research and the identification of fishery resources;
> (3) Whether such nations have cooperated in enforcement and with respect to the conservation and management of fishery resources; and
> (4) Such other matters as the Secretary of State, in cooperation with the Secretary (of Commerce), deems appropriate.21

The State Department has also been designated the coordinating agency between the Departments of Transportation and Commerce concerning seizures of foreign nation's vessels when they are found in violation of the FCMA.

This brief discussion of the roles played by federal and local actors, and their obligations and responsibilities indicates one reason for poor response time in the management process. Sometimes a management

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20Ibid. Sec 201 (d). Total Allowable Level of Foreign Fishing.

21Ibid. Sec 201 (e). Allocation of Allowable Level

strategy will develop by default, because the processes required by law take so much time that other management options can not be adopted in a meaningful time-frame. For example,stonewalling in Council meetings has been responsible for cod fishing closures resulting in uneven burdens even though all the Council members oppose closures.

CHAPTER II: FISHERIES MANAGEMENT OBJECTIVES

OWNERSHIP

Fisheries management involves balancing the full utilizaton of fish with conservation in order to ensure a brood stock and equitable allocation of the catch between user groups. In his book The Management of Marine Fisheries, John A Gulland states:

> ...If fish resources were under single ownership, management would raise few major problems. There would be some scientific work in advising on the best management policy, but the great problems of reaching decisions on what limits should be achieved, would be dealt with as part of the complete procedure of managing fish business, of which the fish resources would be a major capital asset.22

Fishery managers who advocated national control of the resource before the FCMA based their arguments on their feelings that national ownership leads to rational management. After the FCMA came into force, the fishery managers continued to perceive the government as the sole owner of the fish resources and advocated management strategies based on that false assumption. Although the government now controls the fisheries management, the stocks are still considered to be common property.

Common property resources are held in trust by our

22J. A. Gulland, the Management of Marine Fisheries, (Seattle: University of Washington Press, 1974), p.4.

government for the general public and are the property of the first person who reduces them to his possession. Therefore, in the traditional sense of ownership, the government does not own the fish in the sea. Management can only be concerned with regulating the opportunities of the public to reduce the fish to ownership, (catch fish), without creating a privileged or restricted class of individuals who alone are permitted to fish. Therefore, the management of marine fisheries can not be based on any theory that assumes that one individual, a restricted class of individuals, or one government owns them. Who then are the individuals that make up the unrestricted class of people that benefit from conservation? This is a political allocation process decided during the Regional Council's meetings.

CONSERVATION OBJECTIVE

Fishery conservation is the planned management of a natural resource in order to prevent over-exploitation or destruction of fishery resources. In practice, conservation guards or saves a species from harm or change. However, the reason for this protection is so the species can be used to enhance man's welfare. Presumably, this works best on fish stocks that are not being over-exploited to the point of extinction and whose habitat is not significantly altered by man's activities.

Conservation moves the fishing occupation closer to the idea of ranching the sea because it implies that it is

wise to leave at least one bull and cow to produce a new herd of cattle for the farmer's future use. Most fishermen do not oppose the concept of conservation but there is considerable disagreement as to HOW MUCH conservation is necessary and HOW the conservation should be practiced. The controversy can be illustrated with an excerpt from the groundfish management objectives by the New England Fishery Management Council:

> Over the plan period expected the total removals will be established on a yearly basis consistent with the overall objective as constrained by an acceptable probability of achieving the biological stock conditions by the end of the plan period, and a minimum spawning stock level for each species which ensures an acceptable probability of continued recruitment.23

Unfortunately, fishermen are utilizing a common property resource where it is to their short term benefit to exploit the fish stock to their maximum individual ability. For instance, if a sport fisherman releases a small fish in the hopes that it will grow, he knows that the chance of his recapturing the fish is very small. The sport fisherman also knows that if that fish is caught again the next day, the other fisherman will probably not release it. The "logical" conclusion is to enjoy the small fish now and forget conservation. In some respects,

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23Ibid, p.1.

the individual fisherman is similar to the independent sovereign state that seeks to maximize its power in the world, through diplomacy or war, even though the action is not in the long term best interest of either humanity or itself.

FUTURE OPTIONS OBJECTIVE

The FCMA attempts to address the conflict between harvesting more fish today and facing fewer options for future harvests. A conservation objective contained in the FCMA requires that fishery management maintains "a multiplicity of options available with respect to future uses of these (fishery) resources."24 This objective could be useful in rejecting suggestions for fishery management policies that could eliminate a species of fish. For instance, at present neither the commercial nor the recreational fishermen consider the sea robin as anything more than a nuisance. However, a management plan that eradicated the sea robin would preclude an as yet unknown future use for the sea robin.

Another aspect of the "multiplicity of options" conservation objective is the possibility of precluding future harvests because a fish species is presently in need of preservation. Some groups interested in our

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24FCMA Sec. 202.

environment would argue that a fish species whose existence has been threatened through fishing or oil pollution should be preserved for its own inherent value as a unique and irreplaceable creature.

Preservation is a more restrictive concept than conservation because it means to keep or guard from harm, injury, change, or interference, but it also excludes man's rational utilization. Preservation does not maintain a "multiplicity of options" for future harvest as required in the FCMA but it may be the only way to manage some species. The best examples of preservation are on land, where man has been able to exert more control over animals for a longer period of time than in the oceans.

For instance, the buffalo of the Midwest was almost extinct until preservation gave the herds a chance at survival, even though their habitat is largely destroyed by farms and highways. Some biologists would argue that whales are in a situation similar to the buffalo and need preservation in order to survive. One logical way to determine if a fish stock is to be conserved or preserved is to address the question of habitat destruction. If the natural habitat has been altered to a point that continued survival is doubtful, then the fish need preservation.

HABITAT PROTECTION AND ENHANCEMENT OBJECTIVE

Contrary to popular concepts, the ocean is not a

homogeneous mass of water. There are subtle differences in the bottom material, temperature, salinity, and other physical parameters that create unique habitats for the different creatures in the sea. Frequently a species will inhabit several unique niches in the sea as the members pass through stages in their life cycle. To destroy one niche, such as the estuaries used for the juvenile nursery, would threaten the survival of the entire species not just the juveniles.

An example of one method of protecting fish reproduction through habitat enhancement would be hatcheries. Extreme natural variation of year classes coupled with untimely stock assessments create uncertainties concerning the appropriate management plans. Some management uncertainty could be removed if hatcheries could insure a good harvest by supplementing the natural reproduction. If the biologists could learn to raise the juvienile fish through the first stages, which have high mortality rates, they would learn what the species' specific niche requirements are. Unfortunately, the life cycles of most of the commercial and recreational species are not completely understood, so it is difficult to correlate an effect on the fish stock with an environmental catastrophe, such as an oil blowout. The information gained from research could be used to document reasons for protecting specific habitats. The supply of juvenile individuals would guarantee that the species

would not become extinct. The security from extinction would permit more latitude in other management decisions.

CONSUMER OBJECTIVES

Besides the commercial and recrational fishermen, the consumer should be a benefactor of fisheries management. Congress noted in the FCMA that fisheries provide food for the nation but did not specify any other consumer benefits. "For example, although it is a stated objective that fisheries should be managed to assure a supply of food, it is not stated that the quality should be high, that prices should be low, and that supplies should be secure."25 There are very few people who advocate fisheries management for the benefit of consumers and who are interested enough to attend Regional Council meetings in order to secure a reduction in fish prices or prevent the extinction of a species of fish.

The lack of consumer interest is dramatically illustrated by the New England Fishery Management Council's three page statement on management objectives which includes only the following reference to consumers: "In benefits to users we include incomes to harvesters and processors as well as the values to consumers."26 The values to consumers are never defined and yet they are one

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25John E. Kelly. "The Fishery Conservation and Management Act of 1976- Organizational Structure and Conceptual Framework," Marine Policy (January 1978): p. 34.

of the groundfish management plan's purported objectives.

In an ideal management situation there should be a group to oppose the special interests of the commercial and recreational fishermen, such as a consumer group or an environmentalist organization. For example, an effort tax increases the variable costs of the commercial fisherman, reduces the supply of marketable fish, and drives the consumer price up. The fisherman can theoretically pass the extra cost directly to the consumer and be relatively unaffected. If the price to the boat is up, the dealers represented on the Regional Council can justify a larger markup so they will not oppose an effort tax on consumer grounds.

Another example of clashing consumer and commercial goals is seen in the conflict over employment and labor saving technology. If a new, labor saving device were adopted, the reduction in raw product costs would theoretically save the consumer money, but the loss of employment would not please the fishermen. For example, on the United States West Coast, the Pacific salmon return to their home rivers where one strategically placed trap could capture the optimum catch in each stream with very little effort and expense. However, it was determined

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26New England Fishery Management Council, Recommendations for Groundfish Management Objectives, (July 28, 1978, p. 1-3.).

that the traditional salmon fishermen who captured the salmon have little alternative employment and they would become wards of the state if the fish traps were permitted. Therefore the traps were prohibited, and the fishermen continue to capture the salmon inefficiently.

Examples of restrictions on technology (probably the oldest management technique) range from the sail powered oyster boats on the Chesapeake Bay to the hand powered clam hoes in Maine. Managers have justified these restrictions on the basis of stock conservation, because if a new, efficient harvesting method were universally accepted the stock would be depleted. However, the real reason is the managers' inability to deal with the social upheaval caused by the unemployment of a large number of traditional fishermen who could not operate if the new technology were permitted. Historically, in technology versus employment conflicts where there is governmental management, the employment considerations override harvesting efficiency.

COMMERCIAL FISHING OBJECTIVES

According to the New England Regional Council, "management's ultimate aim is to generate the greatest possible social and economic values to the users of the resource."27 One of the purposes stated in the FCMA is to "promote domestic commercial and recreational fishing

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27Ibid, p. 1.

under sound conservation and management principles."28 From this statement it is clear that the commercial and recreational fishermen are classes of individuals who have a special interest in conservation and management.

As well as shouldering an uneven management burden the commercial fishermen lost some important traditional values when they curtailed their fishing in order to comply with the FCMA. Among the traditional values listed by fishermen are such things as beautiful sunsets and sunrises, dynamic weather and sea conditions providing challenge and variety to the job, the hunters skill in finding his catch, and the seclusion from society forcing self-sufficiency. The untraditional closures and quotas have also restricted the fishermen's freedom to make business decisions to maximize their incomes. This has led to some marginal operators loosing their livelihoods and has other fishermen considering some sort of government-backed economic protection.

In the traditional fishery before the 200 mile limit, when the fishermen competed with each other for fish and markets, the marginal operators also went bankrupt but government regulations were not to blame. Most fishermen enjoy competing with each other, but they abhor government

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28FCMA Sec. 2b Purposes.

regulations that remove the opportunity to fish, compete with each other, and succeed or fail through personal ability. An ideal management technique, from a traditional fishing point of view, would protect the stocks from over-exploitation and leave the traditional social and economic structure intact.

PROCESSOR OBJECTIVES

A well represented special interest group on the Council is the fish processors or dealers. This group is interested in management because their businesses need a constant supply of quality fish in order to minimize overhead costs and supply customers. However, it is sometimes desirable for an industry to reduce the supply to force the price up. For instance, the Mid-Atlantic Council has limited entry, trip catch limits, and one day a week trips restricting the surf clam industry. This was supposedly done to conserve the stocks, but most of the surf clam beds have never been harvested in New England. In affect the regulations prohibit the development of the New England resource because the increase in supply would drop the dealers' profit. As a matter of record, the independent fishermen opposed these regulations but the Mid-Atlantic Council has enough dealers to push the regulations through. From a dealer's perspective, any management plan which maximizes dealers profits is a good one.

RECREATIONAL OBJECTIVES

A fourth special interest group that has some conflicting goals both with the commercial industry and the consumers is the recreational fisherman. The recreational fishermen are a very difficult group to regulate because historical catch records are non-existent, and no one knows how much fish they catch. To complicate matters, the value of fishing to recreational fishermen is quite a bit more nebulous then the value to commercial interests.

For example, what is a day on the water away from his business worth to a business executive? How many recreational fishermen should be allowed to fish in competition with the commercial fishermen? In other words, if the commercial fishermen are restricted, should the recreational fishermen be restricted, and if so, how? An ideal management technique would allow first come first serve competition between the recreational and commercial fishermen and still prevent over-fishing.

THE POLITICS OF OBJECTIVES

Closing a spawning area is politically sensitive because fishermen from one state who catch fish only when it is spawning would be excluded and forced to bear more than their share of the management burden which is discriminatory. When discriminatory management objectives such as closures or quotas are considered, the geography of Council voting power becomes a key issue. A market

will reward scarcities in one state with higher prices to fishermen in other states. Therefore, if more than 50% of the Council members are from states not affected by the closure, a discriminatory closure could be a reality.

Here again, we see the possibility for discrimination. Together the representatives from Massachusetts and Rhode Island control 64% of the Council's votes. If they were inclined to, they could force a management decision that would be to their advantage and could be to the detriment of the other states in the region. For example, some of the herring votes split geographically because Maine, New Hampshire, and Massachusetts gained resource distribution to the detriment of Rhode Island.

For instance, a law that closes the fishing season on cod fish from May to August for all fishermen would not on the surface seem discriminatory because it would apply to all fishermen. But practically, it would exclude Maine and New Hampshire fishermen on an economic basis, since this is the time when cod run offshore near these states. The makeup of these Councils is, therefore, important when management decisions that could discriminate between residents of different states are considered.

One of the responsibilities of the Secretary of Commerce mentioned in the previous chapter is the obligation to ensure all of the Standards are met by a fisheries management plan. Standard Four prohibits discrimination on the basis of residency but as long as

the regional effect of the management plans seems balanced, the federal overseers may ignore more subtle forms of discrimination. For example, the New England Council has used closed spawning areas and closed seasons which have caused one group of fishermen economic hardship and have only a minimal effect on other fishermen.

CONCLUSION

The management objectives of the FCMA should be set up to judge not only the utilization and conservaton issues but also the allocation issues. A good set of management objectives should include the following elements: a minimum brood stock size, a percentage of the total catch for the commercial fishermen and for the recreational fishermen, a minimum estimate of stock assessment and enforcement costs, and a determination of an acceptable increase in consumer costs.

The New England Regional Fisheries Management Council groundfish committee addressed the question of groundfish management objectives and produced the following recommendations:

> The overall objective of the plan shall be to generate over the period of the plan the greatest possible joint economic and social net benefits from the harvesting and utilization of the groundfish resource, ensuring that by the end of the period the relevant groundfish stocks shall be in a condition which will produce enhanced and relatively stable yields from the groundfish fishery in future years.29

A fisheries management objective is an aim or goal that should benefit the consumer, the fish stocks, and/or a special interest group. The motives of special interest groups will contribute to the allocation procedures in the management plans that are developed. Even if a plan purports to be based on maintaining the Optimum Yield but is intended to favor one state over residents of other states, it could be adopted by the Council and accepted by the U.S. Secretary of Commerce. Balancing the often conflicting management objectives makes fisheries management a difficult political process.

29New England Fisheries Management Council, p.2.

CHAPTER III. OPTIMUM YIELD

The cornerstone of the FCMA is the requirement that the Regional Council's management deliberations establish a specific amount of harvestable fish called the Optimum Yield (OY) for each managed fishery.30 "The concept of Optimum Yield is broader than the consideration of only the stocks of fish. It takes into account the economic well-being of the commercial fishermen, the interests of recreational fishermen, the habitat quality and the national interest in conservation and management of the fisheries..."31 The following definition of OY in the FCMA can be supplemented with information from the Legislative History of the Fishery Conservation and Management Act of 1976:

> The term 'optimum', with respect to the yield from fishery, means the amount of fish that will provide the greatest overall benefit to the nation, with particular reference to food production and recreational opportunities; and which is prescribed as such on the basis of the maximum sustainable yield from such a fishery as modified by any relevant economic, social, or ecological factor.32

Optimum Yield is a concept which underwent

30FCMA Sec. 303 (a)(3). Contents of fishery management plans.

31Legislitive History. p 1099.

considerable development during the legislative process leading to the FCMA. OY is defined as Maximum Sustainable Yield (MSY the largest average annual catch) modified by relevant economic, social, and ecological factors. It seems clear from the definitions in both the Senate and the House bills that "Optimum," "Optimum Sustainable Yield," and "Optimum Yield" are the same concept. As the title of this act states, the act's purpose is to conserve and manage the fish stocks off our coasts. The principle of conservation is to provide a brood stock that will maintain the fishery in perpetuity. This is done to benefit the humans who are and will be harvesting the fish. The term "benefit" was found by the legislature to be more appropriate than the "largest economic return," as shown by the change in the wording of the Senate bill. Senators Warren G. Magnuson and Ernest F. Hollings introduced Senate bill 961 which stated that:

> "Optimum Sustainable Yield" refers to the largest economic return consistent with the biological capabilities of the stock, as determined on the basis of all relevant economic, biological, and environmental factors.33

This definition was later amended to be:

> "Optimum," with respect to the yield from a

32FCMA Sec. 3 (18). Definitions

33Legislative History. p. 731.

> fishery, means the amount of fish (A) which if produced, will provide the greatest benefit to the Nation; and (B) which is prescribed as such by the appropriate Council and the Secretary on the basis of the Maximum Sustainable Yield from such a fishery as modified by any relevant economic, social and/or ecological factors.34

An important change in the wording is the deletion of economic RETURN and the substitution of benefit. Webster's Collegiate Dictionary defines "return" as "the value of profit from a quantity of goods, consignment, or cargo coming back in exchange for goods sent out as a mercantile venture." The word "benefit" is much less tied to monetary terms. As it is defined by Webster's, "a benefit is something that promotes well-being." In turn, well-being is defined as "the state of being happy, healthy, or prosperous." Therefore the change of RETURN to benefit expands the concept of OY to include non-monetary values such as health and happiness.

Another significant change in the definition of OY is the addition of "social" in the list of modifying factors. Webster's defines "social" as a term "of or relating to human society, the interaction of the individual and the group. Or the welfare of human beings as members of society." For example, from a strictly biological viewpoint the herring or sardines should be allowed to mature so that the maximum weight could be caught. If a fisheries management plan prohibits the

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34Ibid. p. 131.

harvesting of juvenile herring, fishing and eating habits would change. First, the fishermen who have been stop-seining the herring or sardines would no longer have employment. Second, consumers in the U.S. prefer the juvenile herring to the adults, so their eating habits would be modified. Because of these factors, the management plans will probably continue to allow the capture of juvenile herring as well as adults.

The last change in the wording of the definition of OY removed "biological" from the list of modifying factors and added MSY as the biological basis of OY. The MSY is a number for the long-term average harvest from a fishery. As such it only needs updating on a yearly basis and is not dependent on the current size of the stock. The modifications of the OY definition make it clear that only the MSY should be used for the base of OY. To be sure, the best scientific evidence must be used to establish MSY, but only MSY can be used as a base for OY.

If Congress had intended biological factors to be considered in the determination of OY they would have kept "biological" as a modifying factor. Instead, Congress includes "ecological" which is a broader term. The addition of "ecological" expands the concept of OY even further and makes it more flexible because the Councils can legally consider more environmental impacts.

For instance, a dredging operation for harvesting shellfish, could accelerate erosion of adjacent beaches. If the MSY for the shellfish was not exceeded, there would be no biological reason for prohibiting the dredging. However, the erosion caused by the dredging is an ecological problem which may require the prohibition of dredging. The inclusion of ECOLOGICAL instead of BIOLOGICAL as a modifying factor for OY gives the Regional Council the flexibility to deal with this type of issue.

The definition of Optimum Yield in the House bill number 200 stated that:

> The term "Optimum Sustainable Yield" means a yield which provides the greatest benefit to the United States as determined on the basis of the Maximum Sustainable Yield of a stock or stocks of fish as modified by relevant ecological, economic, and social factors.35

When these bills were combined and passed into law the definition of Optimum Yield changed:

> The term "Optimum Yield," with respect to the yield from a fishery, means the amount of fish-
> (A) which will provide the greatest overall benefit to the nation, with particular reference to food production and recreational opportunities, and
> (B) which is prescribed as such on the basis of the Maximum Sustainable Yield from such fishery, as modified by any relevant economic, social, or ecological factor.36

The addition of the words "food production" and "recreational opportunities" to the definition of OY

35Ibid. p. 131.

specifies that both marine fishing activities have equal importance. In the report of the Senate committee of commerce there is a clarification of the concept of Optimum Yield.

> In the past, most fishery management has sought to achieve the maximum sustainable yield from a fishery. The maximum yield (primarily a biological term) is achieved when the annual catch from a fishery is at the highest level without harming the reproductive ability of the stock and which assures a similar level of harvest in the next year. However, many experts believe that use of the maximum sustainable yield objective in fisheries management may lead to substantial economic waste and may ignore important environmental relationships between stocks from which yields can not be maximized simultaneously. It seems more desirable therefore to adopt the objective of optimum yield, defined to include the maximum yield as the basic standard of reference, as modified by relevant economic, social, and/or ecological factors. However, the Committee does not intend that these modifying factors would be used to institute management measures which permit overfishing on a continued basis. Although it may be conceivable that a situation may occur in which a yield higher that the maximum sustainable might be defensible, this would seem rare and should be only temporary. In almost every other instance, the optimum yield should be equal to or below the maximum sustainable yield. It is intended that determining the optimum yield for each fishery ought to be within the discretionary powers of the Councils and the Secretary.37

The House Committee on Merchant Marine and Fisheries submitted the following discussion of Optimum Sustainable Yield:

36FCMA Sec. 3 (18). Definitions

37Legislative History. p. 676-677.

> The preceding concepts relate to the biological wellbeing of the fishery. The concept of optimum sustainable yield is, however, broader than the consideration of the fish stocks and takes into account the economic wellbeing of the commercial fishermen, the interests of recreational fishermen, and the welfare of the nation and its consumers. The optimum sustainable yield of any given fishery or region will be a carefully defined deviation from MSY in order to respond to the unique problem of that fishery or region. It can not be defined absolutely for all stocks of fish or groups of fishermen, and will require careful monitoring by the Regional Marine Fisheries Councils and the Secretary of Commerce. While optimum sustainable yield may have many complex components, their quantification should not be beyond the capability of the broad range of individuals who will serve on the Councils, supported by trained economists and marine biologists. Optimum sustainable yield will, as indicated above, employ a well understood and time-proven concept of maximum sustainable yield as its basis while allowing for other relevant economic and social inputs. The Committee believes that the careful balancing of roles and responsibilities under the Act between the Councils, the Secretary and the public will ensure that these inputs are not distorted and that optimum sustainable yield will achieve the purposes of the Act.38

The concept of OY was invented during the deliberations of the U.S. Legislature. The MSY was found to be too restrictive in its definition to allow flexibility in the fisheries management plans. Therefore, the sole biological basis of OY is MSY. OY, however, includes modifiers to expand the scope of the Regional Council's deliberations. The concept of Optimum Yield was

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38Ibid. p. 1099.

given statutory recognition because it allows flexibility in the process of determining what amount of fish can be reasonably removed from the fish stock without harming its reproductive capacity.

In practice, the complex components of Optimum Yield have tested the abilities of the broad range of individuals who have served on the Councils. Conflicting goals of special interest groups on the Councils and the ambiguous interpretations of the relationship between the Maximum Sustainable Yield and OY have contributed to the difficulties experienced in instituting the FCMA.

OY is not intrinsically a discriminatory concept, but the political process of determining it is open to manipulation. For example, the Council wanted to exclude foreign fishing of butterfish. According to the FCMA any portion of the OY not caught domestically must be assigned to the Total Allowable Level of Foreign Fishing (TALFF). In order to reduce the TALFF the OY was set just above the expected domestic catch leaving only a small TALFF. The market for butterfish is almost entirely foreign, so if the foreign demand could be filled by foreign fishing off our coasts there would be no domestic harvest. There has not been a clear domestic example of discrimination caused solely by the selection of the OY but a similar situation could occur.

The choice of tools to implement a Fisheries

Management Plan (FMP) is directly related to the OY, the amount of fish the Council intends to be caught. A low OY leads to allocation issues which can and does create uneven management burdens. A low OY could also be chosen to force other members of the Council to agree to unequitable management techniques to be included in a FMP. In either situation the MSY is the sole biological basis for OY prescribed in the FCMA. The biolgical methods for establishing the MSY become important because if members of the Council want to manipulate the outcome of the OY deliberations they must manipulate the MSY. The next chapter explains the biological basis of MSY.

CHAPTER IV. MAXIMUM SUSTAINABLE YIELD

Maximum Sustainable Yield (MSY), the starting point or sole biological basis for OY, is a concept which is not fully defined in the FCMA. For instance, the acceptable confidence limits of MSY were not defined, and the relationship of MSY to one species or the whole biomass was not specified. In the Federal Register under Guidance for Regional Fishery Management Councils NOAA stated that:

> The MSY from a fishery is the largest average annual catch or yield in terms of weight of fish caught by both commercial and recreational fishermen that can be taken continuously from a stock under existing environmental conditions. A determination of MSY, which should be an estimate based upon the best scientific information available is a biological measure necssary in the development of Optimum Yield.39

It is necesesary to understand the collection process for the "best scientific data" if some conflicts over the relationship of the OY to the MSY are to be comprehended. The Maximum Sustainable Yield is a complicated figure to calculate, but the theory behind it is quite simple. First the fishery scientists figure out how many fish exist in a stock and how much effort is needed to catch the fish. From these a graph can be produced showing the

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39United States Department of Commerce, National Oceanic and Atmospheric Administration. Guidance for Regional Fishery Management Councils (Tuesday, July 5, 1977). p. 34458.

effort necesesary for the maximum catch. If the council's Optimum Yield deliberations start with a low MSY estimate, the result will probability be a low OY. A low OY results in allocation decisions which have burdened residents of different states with uneven management costs. The following is a discussion of how MSY is determined.

For each species the total population of fish is called the stock. The stock constantly fluctuates, due in part to the entrance of young fish called recruits. These recruits, along with the other more mature fish, grow with time and increase the total weight of the stock. At the same, time there are fish dyeing from old age or being eaten by other fish. This natural mortality is distinguished from the fish that die because they are caught by man. (figure one)

VIRTUAL POPULATION ANALYSIS

In order to harvest fish and conserve a brood stock the magnitude of recruitment, growth, natural mortality, and fishing mortality must be known (figure one). The fishing mortality can be estimated using the commercial landing statistics for data. The NMFS collects sampling statistics on the age of the landed fish by counting the number of growth rings on fish scales. The number of fish of each year class is estimated using length/frequency data. Over the life span of each age class the number of fish removed by commercial fishing can be totaled. This process is called cohort analysis or virtual population

analysis and assumes that if the fish were caught by the fishermen they must have existed in the first year of recruitment.

Figure two gives an example of a virtual population and clarifies this part of stock assessment. In 1920 a certain unknown number of fishcrats were born. Because all young fishcrats look like all other juveniles we cannot tell which ones will be fishcrats. Therefore, we cannot simply count juveniles to determine the number who will become fishcrats. But if we record the number of dead fishcrats each year from the 1920 year class, as is done in the row labelled (LANDED) in figure two, we can total all the fishcrats landed each year. Common sense tells us that if they dyed, they must have been there in the beginning. The total dead is recorded in the row labelled (TOTAL). In 1921 there must have been at least 32 fishcrats alive. Two fishcrats dyed in 1922 leaving at least 30 at the end of 1922. The pattern is followed across the row labelled (REMAIN). The graph below the table shows graphically the virtual population always will be lower then the real population because the landing statistics cannot be used to estimate natural mortality.

Virtual population analysis is based on the assumption that the catch statistics must be reasonably accurate and that the natural mortality is known or estimatable. Also a true estimate of fishing effort is needed as the time series progresses, and the biological

characteristics such as length to age, growth rates, etc must be known. These assumptions are questioned by the commercial fishermen because they know from experience that the catch statistics are incorrect. For instance, I was once unloading a boat full of whiting when the captain was interviewed by a NMFS data collector. The captain did not mention his whiting catch to the collector. When the NMFS man left, all the fisherman had a good laugh; however the false information was dutifully entered into the data base which today forms the statistics for MSY. The fishermen also question the accuracy of any estimate of fishing effort. They know that a small change in fishing gear can have tremendous consequences on the catch. Therefore they conclude any estimate for effort or potential effort is ludicrous.

While there is general agreement about the patterns of growth used in calculating the virtual population, the specifics are difficult and expensive to document. For instance, it is known that if the adults which eat the same food as the recruits are removed, the recruits grow faster--presumably because they have more food. Also, if a year class is exceptionally large, the individuals will grow slowly and mature late. In this case, early harvest is like thinning a forest so the survivors can grow better. Raising the OY in time would permit the early harvest without jeopardizing the brood stock.

Inflexible management plans and enforcement

procedures have led to discriminatory closures. For example an exceptionally large year class of herring supported a large summer fishery in Maine. A closure was recommended by the NMFS because before the winter fishery conducted by Rhode Island fishermen was started the entire OY was taken in Maine.

If a year class is followed through its life cycle, the number of individuals is very high at first, but they are rapidly eaten or die for other reasons. As the fish get older, they die at a slower rate. The weight of each fish is low at the start but young fish gain weight rapidly until maturity slows the process. If the average weight of a fish in a year class is multiplied by the number of fish in the year class, the result is the total weight of the year class. Figure three shows these relationships graphically.

AREA SWEPT CLEAN

Virtual population analysis by itself has a limited usefullness because it can only be done on a year class which has already been caught or dyed so all management proposals will not change the lives of the fish which were counted. However, a virtual population analysis can be used as a check on the other stock assessment methods that estimate the present abundance of fish. The "area swept clean stock assessment method" is used by the NMFS to estimate the present abundance of fish.

The area swept clean method assumes that a biologist

can tow a standard net through the grounds, that the fish are evenly distributed over the bottom, and that his net catches every fish which is in its path. The total number of fish in the stock can be calculated by multiplying the total area of the fishing grounds by the amount of fish caught per unit area swept by the net. Figure four depicts the process of stock assessment using the area swept clean method.

Of course, any study is only as good as its assumptions. Fish are not evenly distributed over the fishing grounds and if only one tow were used the results would be totally false. However, the central limit theorem from statistics states that the average of an infinite number of random samples of a nonrandom population is the average of the population. It means that a very large number of random tows must be made in order to mitigate the errors introduced by the assumption that the fish are evenly distributed over the bottom. Fishermen scoff at the number of samples used by the NMFS as the basis of their data collection because they know that moving only one hundred yards will sometimes triple their catch. In statistical terms, the fishermen are saying that fish are in tighter schools of higher concentration then the NMFS statistics show. This means that the random samples made by the NMFS almost never sample the high concentrations of fish, according to professional fishermen. The scientists answer this charge

by stating that the central limit theorem requires that, if the results are to be of any value, they must sample randomly and use the average concentration. At this point the scientist's credibility is so low that the fishermen are certin that if a man were standing with one foot on a block of dry ice and the other foot in a bed of hot coals, the scientists would say that, on the average, the man was comfortable.

Commercial fishermen would also disagree with the assumption that all the fish in front of the net are caught. For instance, a fisherman from Point Judith Rhode Island was fishing for butterfish alongside a group of boats and catching about four thousand pounds per tow. He then adjusted the sweep on the net by three inches (less than three tenths of one percent) and caught nearly thirty thousand pounds in the next and subsequent tows. The other boats continued to catch about four thousand pounds per tow. Fish catch rates are a function of the gear, the operating environment, and the operator's skill. However, the fishery scientist counters this charge by pointing out that the trawl survey is compared against the virtual population analysis to arrive at an index of sampling efficiency. In other words, the fishery scientist is saying that the commercial catch rates are used to check or correct the results of the survey.

VIRTUAL POPULATION VERSUS AREA SWEPT CLEAN

The NMFS uses the virtual population analysis of past

year classes that had the same stock assessment level to say that there are the same number of fish available for future harvest as were available in the historical or virtual population. Put another way, the area swept clean survey is used only to determine the relative abundance assumed to exist today. This type of correlation reduces the objections to the assumptions in the area swept clean method of stock assessment, if the survey is done precisely the same way each year.

Fisheries biologists also estimate the future stock by computing the amount of growth there will be in the stock, the amount of recruitment, the fishing mortality, the age ratios, and the size of the brood stock necesesary to ensure a new year class. In fact, the computer models are now being modified to include sociological data on the fishermen in order to estimate their responses to management plans. When these complex computer models are complete, the fisheries managers will have an on-line, real-time management information system that should be capable of answering any question. Many fishermen feel that computer modeling is a means to a secure future for the scientists and statisticians, because if the computer were asked if there is a God it would answer, "There is now." The average fisherman is not capable of evaluating the precision or the applicability of these assessment methods or the computer software used to manipulate it. However, judging from their experience with the

assumptions made in order to conduct stock assessments, they generally disbelieve the scientific evidence.

FISHING EFFORT AND YIELD

After the size of the fish stock has been estimated, the next step in determining MSY is to determine how the stock size is related to fishing effort. The scientific assumption is that the stock size is equal to the fishing effort times a constant. This means if there are more fish in the sea, the fishermen will catch more fish for his effort and, conversely, the fewer the fish the lower the catch. This seems to be a logical statement but the underlying assumption of catch per unit effort must be explored.

The number of vessels fishing times the number of days fished is an estimate of effort exerted. In order to make this calculation, the statisticians assume that all fishing boats are the same size with the same power; that the boats all tow the same size net on identical fishing ground with random fish density; that the net is towed the same number of hours every day fished; and that the captains and crews are identical. Even a casual observer can see this is not correct, so the statistician creates a formula to account for as many factors as possible. However, fishermen point out that the human factors alone can overshadow any vessel factor. A vessel may be an excellent producer in a fishery in one area but may be uncompetitive in another area or fishery.

After the scientists calculate the amount of effort exerted by the recreational and commercial fishermen, they need to know the yield or amount of fish caught by this effort. This data is collected by NMFS data takers at the port or is reported by the dealers. The reliability of these figures in reflecting the real catch level is based on a number of assumptions: that there are no fish sold off the boats for unreported cash; that there is no "shrinkage" taken out of the landing figure reported; that the scales used to weigh the fish are accurately operated by an honest person; that all the fish unloaded from the boats are recorded; that the fish species is correctly reported; and that there is no discarding at sea. Again, the fishermen know from experience that these assumptions do not reflect the real world. Yet this data is the basis for "the best scientific evidence."

The effort/yield function (figure five) is the result of combining the statistics on stock size, effort, and catch data. This type of relationship between catch and effort is not unique to fish populations. It is found in all exploited natural populations such as a deer herds. This unique situation of having the population hidden below the surface of the sea creates more errors in the collection of data. The error in fish stock assessments is the sum of the error caused by inaccurate assumptions and the error inherent in data collection systems. For example the 95% confidence interval for cod fish is

graphed in figure six. The plus or minus 50% may seem excessive, but actually it is a very good fish stock assessment that can boast this accuracy. In layman's terms, this means that if the catch of fish were watched for one hundred years, the catch would vary plus and minus 50% for ninty-five of those years. Instead of recommending that the NMFS data be ignored because of the imprecision, the fishermen should realize that if the statistician and fishery biologist can give the confidence interval of the assessment, they have done the best job possible with the given resources.

THE POLITICS OF SCIENCE

This process of establishing the effort/yield graph and the MSY should be a purely scientific process devoid of bias and politics. However, "the National Marine Fisheries Service is...in a strategically advantageous position to become the primary source of data which the regional councils need to establish MSY."40 The FCMA requires that the MSY be established using the best scientific evidence available, and in most cases, the NMFS has the only scientific data. Therefore, the NMFS has the best scientific evidence. The regional councils are responsable for establishing the OY. The FCMA defines OY as a figure "prescribed as such on the basis of the

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40John E. Kelley. "Organizational Structure and Conceptual Framework" Marine Policy (January 1978). p34.

Maximum Sustainable Yield...."41 MSY is therefore the legal starting point for OY. However, at a regional council meeting, Richard Hennemouth, the then assistant director of the NMFS Fisheries Center of Woods Hole, stated that "for all practical purposes, MSY no longer exists."42

This statement is at the base of many of the problems between the councils and the NMFS. It indicates that the scientists are basing their management recommendations on theories which are one step beyond the concept of MSY. The scientific data that they have collected can be used to establish the average catch of fish from the stock, or it can be used to estimate the current level of stock. Assuming there is an optimum brood stock level, the scientist can also calculate the best level of removal from fishing. This shift in data interpretation is a shift in theory from maintaining a maximum catch to maintaining an acceptable level of brood stock. The fishermen want a maximum catch and the biologists are not giving MSY calculations any credibility because MSY does not agree with their current theory of fisheries management.

The ultimate objective or result of the regional

41FCMA Sec. 3 (18). Definitions

42Richard Hennemouth. New England Regional Council Meeting, Peabody Massasachusetts March 10, 1977.

council's management deliberations is the establishment of the OY for each species in the fishery. However, to establish OY, the MSY must be established. Given the wide confidence intervals, or large error in the MSY, it is not difficult to understand the confusion when the regional councils deliberate the social, political, economic, and environmental modifications to a hotly contested MSY.

The MSY for a fishery is usually contested because a low MSY creates a low starting point for the OY. This leads to a low OY, which the industry dislikes because it restricts fishing. When fishing is restricted, there is a potential for discrimination against residents of different states. For example, the peak fishing season occurs during different months for different states. When a low MSY has led to a low OY and a closure of fishing is ordered, the residents of the state that has its normal fishing peak concurrent with the closure is hurt economically more than fishermen of other states.

CHAPTER V. MANAGEMENT TECHNIQUES: IMPACTS ON THE ECONOMICS OF THE INDUSTRY

One economic theory asserts that societies best interest is served when the maximum amount of fish is caught with the minimum amount of effort. The underlying assumption is that because the beneficiary of the common property fishery resource is society at large the fishery should be managed as if society owned the resource. In order to distinguish economists believing in this theory from others the term "our economist" will be used below. When our economist assumes that the fish are under single ownership and that the biologists can formulate an accurate relationship between catch and effort his recommendations on how to manage the resource cause the industry a great deal of consternation. As the starting point for fishery economic, theory our economist assumes that the stock assessment process gives an accurate graph of catch-to-effort and that the fish are owned by the government as the logical representative of society. As mentioned earlier, the fish are held in trust by the government for the general public, and ownership does not start until they are caught. This ownership assumption leads our economist to the conclusion that rational fish harvesting should be based on the cheapest way to catch them, as if they were owned by one owner. The fishermen, on the other hand, point out that there are thousands of fishermen who harvest the fish basing their

decisions on individual economic factors. An examination of the industry economics will clarify the points of conflict and the basic theory.

INDUSTRY ECONOMICS

In order to examine the industry economics, it is necessary to have a graph relating the catch to a unit of effort, such as the one shown in figure five. The concept of ex-vessel price is introduced by multiplying the price by the total catch. If this is done for each point of the graph in figure five, the results can be graphed showing the relationship between revenue generated and the effort necessary to generate it (figure seven).

In order to quantify the effort, our economist would introduce the concept of standard vessels. All standard vessels have the same skipper and crew, the same power, the same hull, the same fishing gear; in short, every detail of the vessels is the same. The fishing industry is assumed to be entirely composed of standard vessels. The Council's fishing industry representatives are quick to point out this is not true, but assume that through work and luck, it can be done. The results can be graphed (figure eight) using the vertical axis for dollars and the horizontal axis for standard vessels.

EXPLOITATION OF A VIRGIN STOCK

The next graph shows an economist's view of what happens in an industry when a virgin stock of fish is exploited for the first time. The older fish, which would

have been caught at an earlier time if the fishery had reached a steady state, are immediately available for harvest. Temporarily, the catch rates will be high, so the revenue curve also will temporarily be held high. The extra revenue and profits will encourage standard vessels to enter the fishery until the total cost curve crosses the temporary total revenue curve (point A in figure nine). The longterm or steady-state total revenue curve indicates that a management plan should have restricted the number of fishing vessels to the long term requirement for harvesting the MSY (in this case approximately one hundred and twenty). Our economist would then assert that the same amount of fish could be harvested in the long run and that society could use the capital which would have been used to construct excess vessels for an alternative investment.

In most cases the demand for fish and inflation has increased the fish price. Assuming that the large fixed cost portion of the operating expense will stay constant over the short run, the total revenue curve will shift up without a major cost shift (figure ten). If the price increase is great enough, it will shift the total revenue curve up so that even though the same fish could be harvested with fewer boats, the cost and revenue curves will intersect. To the fisherman, this means that he is still making a profit and that our economist's doomsday predictions are wrong.

A CHANGE IN PRICE

The increase in price, shown in figure ten, will encourage new entrants into the fishery and cause over-exploitation. Specifically an increase in price will cause the total revenue curve to shift up and the intersection of the total cost curve will shift to the right. This right-hand shift is proportional to the number of new vessels encouraged into the fishery. Conversely, a decrease in the price will force some fishermen out of the fishery. Economists would argue that the fishermen are mixing issues when they point out that the increase in price will offset the decrease in catch. Our economists would maintain that with a good management plan the same amount of fish could be harvested using fewer vessels.

COST CUTTING TECHNOLOGY

Our economist would also maintain that a new cost-cutting technology would encourage an excess of fishing vessels to enter the fishery. For example, if a vessel installs a Kort Nozzle, the fuel consumption will drop by ten per cent. The same amount of fishing at a lower cost causes the intersection of the cost curve and the revenue curve to shift to the right, indicating to our economist that new vessels will enter and cause excessive harvesting capacity (figure eleven). Our economist would recommend that a management plan should tax the excess profits making the industry less attractive to new

entrants.

CATCH PER UNIT EFFORT

A change in catch per unit effort occurs when a more effective method of catching fish is introduced (figure twelve). For example, the menhaden boats started using airplane spotters, which direct the boats to the fish and increase the catch rate. The vessel could then make more sets in a day and, consequently, the standard vessel became more efficient. The total revenue curve shifted to the right, and, from our economist's viewpoint, the existing fleet was suddenly too large to efficiently harvest the fish. To counter this, our economist would either recommend a technology restriction or a limited entry and buy back program.

VESSEL ECONOMICS

Our economist's view is based on the assumption that the fish are owned by one government and should be managed through treating the industry as an individual. In the real world fishermen are individual businesses that maximize their own share of the wealth. The fishermen's economic decisions, which in aggregate constitute the industry, need better explanation in order to understand the actual system. A management technique can then be hypothesized, and the aggregate of the individual reactions can be anticipated.

The economic system for a sixty foot trawler is graphed in figure thirteen42. Once a fishing vessel is

constructed, it is locked into a system of relationships between its cost of operation and the number of days it fishes. This can only be changed by constructing a new vessel or investing in a modification. In the short run, or on a day-to-day basis, the vessel must operate according to this system. The fisherman can only adjust the number of days fished in order to adjust his income.

The average fixed cost (AFC) are calculated by dividing the fixed costs (FC) by the number of days fished. Fixed costs (FC) are such things as mortgage payments, docking fees, or license fees. All fixed costs (FC) exist whether or not the vessel goes fishing.

The average variable costs (AVC) are calculated by totalling such costs as fuel, ice, food, or gear repair and dividing by the number of days fished. Variable costs generally increase as the vessel is fished more days. Labor would be a variable cost in most industries, but in the fishing industry labor is a function of the gross stock or landed value. Therefore, it is not included in this case.

The average total cost (ATC) is the sum of the fixed (AFC) and variable cost (AVC). The marginal cost (MC) is

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42The data for this graph was supplied on a confidential basis from a vessel operating in the New England fleet.

the change in total costs divided by the change in days fished.

Competition for scarce fish resources and poor markets will tend to lower the vessel's revenue curve until the vessel is operating where its marginal cost curve (MC) and its average total cost curves (ATC) intersect. If the revenue is reduced lower than this intersection point the vessel is not economically viable. If the Regional Councils are considering a management technique which causes one group of fishermen to shoulder a larger share of the management burden then the intersection of the marginal cost and the total cost curve will indicate whether a vessel will fail under the new regulations.

By using these calculations and graphs, the minimum gross stock for any particular number of days fished can be estimated. This means that, for this boat, if a fisherman plans to fish for 225 days in a year he must catch enough fish to gross $1020 a day in order to cover labor and vessel costs. A fisherman will plan his fishing strategy according to the price and availability of fish. Fishermen fish for money and not for fish. For instance, if the price is fixed at thirty cents a pound, the fisherman must bring in three thousand, four hundred pounds in order to stay in business.

A FISHERY IN EQUILIBRIUM

This relationship between the number of days fished,

the price per pound, and the quantity of fish caught per day is graphed in figure fourteen. The bottom graph shows the relationship between catch and price for three levels of fishing activity for our standard vessel. For example, if a line were drawn from the price at thirty cents horizontal across the page it will intersect the 200 day curve at an average catch of 3500 pounds per day. This graph, along with the other two which were introduced earlier, will be used as a tool to graphically compare our economist's views on management with the effect on the industry.

REGULATION BY PERMITS OR FEES

Regulation by permits, fees, or limited entry, increases the fixed costs of operating a fishing vessel. In the case of charging a fixed fee for management control, it is easy to see how the fixed costs will go up. In the case of limited entry, a cash value accrues to the right to fish, thereby increasing the fixed cost. A person who wants to enter the fishing business would be willing to pay the current permit-holder money for the right to fish. In order to finance the purchase of the license or to forego the interest payments of the money in a bank account, the current owner must be earning a premium using the license.

Consequently, the average fixed cost curve (AFC) graphed in figure fifteen shifts up when a management technique is used which increases the fixed cost of

operation. The average total cost (ATC) also shifts up in direct proportion to the shift in the average fixed cost (AFC) curve. The resulting shift upward and to the right of the intersection point between the marginal cost (MC) curve and the average total cost (ATC) curve indicates that the vessel will tend to fish more days each year and it must earn more revenue on each trip.

The increase in required revenue will cause each isoquant curve to shift up and to the right. If it is assumed that the price of fish is beyond the control of the fisherman, then the isoquant diagram indicates that the vessel must catch more fish. From an aggregate of these individual responses it can be concluded that the industry would improve their technology in order to catch more fish each day.

On the other side of the discussion there is our economist who looks at the industry cost/revenue (TC/TR) curve. He sees an increase in the slope of the total cost line and a shift to the left of the intersection with the total revenue curve. He would conclude that the regulation by permits, fees, or limited entry should force some vessels out of the fishery and decrease the fishing effort. In fact, some of the marginal operators would go bankrupt and leave the fishery. But those who stayed would be fishing harder and catching more fish. The net effect would most likely be negligible in terms of fishing effort and industry costs.

Regulation by permits and fees cannot discriminate between fishermen on the basis of residence unless they are flat fees and there is a consistent disparity in the size of vessels of the states. The change in the ratio of fixed to variable costs is inversely proportional to the size of the vessel. In other words, the small vessels would pay a larger percentage of their potential revenue for the privilege of having a permit to fish.

Standard Five prohibits a FMP which has economic allocation as its sole purpose. Permits and Fees do not reduce fishing effort so their sole affect is economic allocation in favor of the large operator. Standard Four prohibits discrimination against residents of different states. If most of the vessels of one state are smaller than another state's fleet, permits and fees would violate Standard Four. The Regional Councils should be concerned about both effects because permits and fees are at least unfair to some segments of the industry.

REGULATION BY EFFORT TAX

Fisheries management regulations, through taxes on fuel, ice, or the number of days fished, cause an increase in variable costs. In affect, taxes of this type are effort taxes, because a fishing boat would only pay them when it engages in fishing. Effort tax regulation is very visible to the fisherman, because the tax is paid every day, so it would be politically unpopular and difficult to enforce.

With an effort tax, the average variable cost (AVC) curve shifts upward (figure sixteen), and the marginal cost (MC) curve shifts upward as a result. The intersection between the marginal (MC) and average total cost (ATC) curves shifts upward and to the left. This means that the fisherman in our example will decrease the number of days fished, but he will need an increase in revenue each day he fishes. The isoquant curves will shift to the right and upward just like the fixed cost increase discussed earlier.

The isoquant curves show that the fisherman would be forced to increase his daily catch, if the price is assumed to be outside his control. The aggregate impact of regulation by effort tax would be to decrease the number of days fished, but increase the pounds taken each day. It is unreasonable to assume that the fishermen would not have already adopted any method which could increase their catch. Although, these effects would tend to cancel each other the real effect would be to force some fishermen out of the business.

Our economist, on the other hand, sees an increase in the slope of the industry total cost line and concludes that an effort tax would be a rational way to decrease fishing effort. Like the case with fixed cost regulation, some of the marginal operators would fail, but those left in the industry would develop more efficient ways of harvesting fish. Although our economist would not view

this as an undesirable trend, he may question why society should force technological changes with a technique that is only marginally effective at reducing fishing effort.

Effort tax regulations would change the ratio between the fixed and variable costs, such as the fixed cost tax. The overall effect would be to favor the under 60 foot vessel. The 60 to 100 foot vessels would be hard hit, but the 100 foot plus would have only a minor disadvantage. This means that Standard Five may be violated, but Standard Four is not, unless there is a disparity in the size of vessels between the states.

REGULATION BY QUOTAS

Regulation by quotas does not affect the individual boat's cost curves or the industry cost and revenue curves. The impact of quotas is on the isoquant curve. Figure seventeen shows that if a vessel is given a total quota, it theoretically could fish 200 days and catch 2750 pounds per trip. As long as the price is 39 cents per pound it could make a living. Another theoretical strategy would be to elect to catch 11,000 pounds per trip with the price at 18 cents per pound. However, in reality the size of a days catch can not be controlled by the fisherman. Therefore, a quota system determines not only the amount of fish available but also the price that must be paid for the fisherman to survive and the number of fishing days. A quota is perhaps the most untenable management device because the fisherman loses all ability

to adjust his income.

In practice the fishermen have been able to evade the quota by landing fish that are claimed to be caught inside three miles or by landing in several ports. Another trick is to sell cod for haddock or pollock and not record the sales properly. In essence, quotas remove the freedom of a fisherman to operate his vessel at its most efficient rate, unless he commits a criminal act. The use of quotas have also not attained the Council's management objective of conserving the resource.

If the catch from the Fishery Conservation Zone is taken evenly throughout the year by the fishermen from one state and in a short season in another then quotas would violate Standard Four. Seasonal catches are caused by the migration patterns of the fish as they react to seasonal changes in food, temperature, etc. and not by the type of fishing vessels involved. With a trip limit, fishermen from some states are economically excluded from specific fisheries because in a short season the catch is often very high, and a trip limit would not allow a high enough catch to average with the low off-season catch. In the off-season, any limit would be high enough because the fishermen can not catch fish anyway. Consequently, this fisherman cannot afford to fish the species in the traditional season so he will fish for the next best specie and his net profits for the year will be reduced.

Contrast this effect with a fisherman who fishes

steadily year round and is able to bring in his limit every trip. In a lean fishing year which occurs periodically, the economic exclusion caused by a quota on a traditional catch can force fishermen from one state into bankruptcy without forcing all fishermen into bankruptcy. If this effect is not discriminatory then quotas are not discriminatory and Standard Four is not violated.

REGULATION BY CLOSED SEASON

Regulation by closed season affects primarily the choice to fish the right number of days for each vessel. In the example shown in figure eighteen, the season is closed after 100 days of fishing. This does not alter the cost curves for the vessel, but it does fix the cost per day fished at a higher rate than the fisherman would achieve while operating on his own. In practical terms this means the fisherman must pay his fixed costs in fewer days of operation than he did before the closure. Assuming that the fisherman cannot increase the amount of fish he catches every day, the only possibilities of remaining profitable are to fish for something else or have a substantial increase in the price.

A closed season fixes the number of days for a fisherman to operate in a fishery and consequently fixes the isoquant line for each fisherman's operation. The price is fixed outside a fisherman's control and the catch per day is fixed by the environment. This means that a

fisherman has no way of responding to the fluctuations in the operating factors except by changing the target species or getting out of the business.

If a species is regulated with a closed season, the market will be flooded with fish during the open season and the prices will be depressed until the season is closed. When the season is closed the prices soar, but the fishermen cannot go fishing. This causes excessive capacity in fishing vessels and in the processing sector, which remains idle during the off-season. Consumers require a constant supply of fish if they are going to maintain or expand their use of fish. A closed season eliminates this possibility and decreases consumer demand. Consequently a closed season causes the price for the fish to decrease.

The short term effect of a closed season is to force fishermen to continue fishing for an alternative species. This means that the alternative species will have too many vessels depending on it for survival and it will soon be regulated as well. The fishcrats would assume that if all the species are regulated some of these vessels would become marginal and get out of the industry. In fact in the short term this would happen, but in the long term the size of the vessels would reduce in order to align the intersection of the marginal cost curve and the revenue curve with the number of days available in the season. The number of vessels would increase and the fish stocks

would be once again overfished. Unfortunately, the new small vessels would not be competitive if the closed seasons ended so removing the closures would be politically unpopular.

The economic hardship caused by closures is more damaging to the fishermen from some states than from others. This would happen if the closure occurred in the high catch season of one state and in a low or average catch season of another state. The residents of one state would be effectively stopped from participating in the fishery.

The seasonal migrations of fish stocks cause the fishermen from different states to fish for different species at different times of the year. The fishermen must catch the closest fish to his port, the fish which is in season or the most plentiful at the time, and the fish with the best price in order to be competitive with other fishermen from other countries and states. A closed season of the species of fish which is traditionally caught will cause the fisherman to travel farther from port, fish on the next most plentiful fish, and have one less choice in the price category.

This means that his average costs will increase and his average revenues will fall. This double-edged squeeze will ensure that he is less competitive than his counterpart in another state who was not eliminated from the fishery by a closure. In those lean years the

fishermen from the states where the closures eliminate them will go bankrupt before their counterparts in other states. If this is not a discriminatory effect then closed seasons are not discriminatory and do not violate Standard Four of the FCMA.

REGULATION BY RANDOM CLOSED AREA OR MESH SIZE

The type of regulation that would please the fishermen would not affect his personal set of economic curves. It would instead affect the industry wide cost revenue curves. Examples would be mesh restrictions, hook size limits, or random closed areas. A discussion of the random closed areas will clarify the economic consequences as well as the social implications of this type of regulation.

The concept of random closed areas may be compared to a checker board, such as a loran-c grid, placed over the fishing grounds. Every other square would be closed to fishing. The size of the closed areas could be adjusted to respond to natural fluctuations in the populations of fish. The system would work by reducing the catch per unit effort experienced in the industry (figure nineteen). The first effect is to shift the total revenue (TR) curve to the right. In response fishermen would spend more days at sea and the industry total costs (TC) would increase and shift the curve to the left. Both shifts indicate the resource would be conserved. However, the individual vessel's cost and isoquant curves would not change. There

is something to be said about a system that forces a fisherman to leave the system because he could not adequately compete rather than because the rules were unjust. Contrast that to a system which does not allow the traditional fishing adjustments, or imposes direct economic pressure on the fisherman.

An advantage to this type of management is its ease of enforcement. Aside from the fact that the fishermen could report violators because the rules are easy to understand, the Coast Guard need only fly over a closed area in order to check by air if the fishing gear is deployed. Another way to enforce the closure is to install loran-c digital tape recorders that could monitor the boat's engine performance as well as the boat's position to prove a violation.

Mesh size or random closed areas do not change the existing economic system that the industry is used to. If it is practiced carefully and only the adults are harvested after they reproduce once, this type of regulation could achieve all the standards set forth in the FCMA. In particular Standard Four is not violated because no discrimination would take place on the basis of residency.

CONCLUSIONS

In summary, there are five categories of management techniques:

(1) The methods of management that increase the fixed

costs of the fishing vessels are permits, fees, and limited entry. Fixed cost management techniques probably do not violate Standard Four but they have economic allocation as their only effect which may violate Standard Five.

(2) The methods that increase variable costs are effort taxes on days fished or a fuel tax. Effort taxes force the industry to fish more days per year and try to catch more fish each day. Therefore, they are ineffective tools to regulate the fisheries.

(3) The methods that interfere with the price and catch relationship are quotas and subsidies. These techniques cause an uneven burden of management costs. If the uneven burden forces some fishermen out of a business then these management techniques appear discriminatory.

(4) the methods that fix the time spent fishing are closed seasons or end of season quotas. This group of management techniques have the same effect as those mentioned in section (3).

(5) The last category is methods which affect the industry revenue cost curves. These include gear restrictions, vessel restrictions, size of fish limitations, and closed areas. This category has the least discriminatory effects and will eventually be accepted as the only way to fairly manage a fishery.

Politically speaking, the fishery biologists prefer a system of management which includes limited entry, but

they would be satisfied with quotas and closed seasons if the OY were not raised every time there is a closure. Economists will push for limited entry and feel the mesh regulations and closed areas are useless. The fishermen do not like the quotas and closures and would prefer techniques which affect the industry cost revenue curves.

CHAPTER VI. DIFFERENTIAL IMPACTS OF MANAGEMENT TECHNIQUES

This chapter attempts to answer the following basic questions: (1) Does a management technique violate Standard Four by discriminating against residents of different states? (2) If the management technique does not violate Standard Four, should the Secretary of Commerce and the Regional Fisheries Management Councils take corrective action to avoid uneven management burdens?

The Secretary of the Department of Commerce has been empowered to ensure the fisheries management plans are consistent with the seven National Standards set forth in section 301 of the FCMA of 1976. Although all seven Standards are of equal weight for legal purposes, Standard Four is of primary importance in this paper. Standard Four prohibits discrimination of fishery management plans between residents of different states. Examination of the legislative history will help clarify the meaning of discrimination in this context.

> (4) Conservation and management measures shall not discriminate between residents of different States. If it becomes necessary to allocate or assign fishing privleges among various United States fishermen, such allocation shall be (A) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and (C) carried out in such a manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges43.

DEFINITION OF DISCRIMINATION

The key word in this Standard is "discriminate." Websters defines "discriminate" as "to make a distinction in favor of or against one person or thing as compared with others." Then, Standard Four prohibits management techniques which make a difference or distinction between residents of different states. Standard Four also has instructions as to how to prevent discrimination. If the management plan is "fair and equitable to all such fishermen," "promotes conservation," and ensures that no "entity acquires an excessive share," then it is not discriminatory.

BLATANT DISCRIMINATION

There are blatant examples of discrimination in fisheries regulations, as exemplified in the Douglas vs. Sea Coast Products lawsuit. The case was the result of a Virginian law that excluded all fishermen except its residents from participating in the menhaden fisheries inside its state waters. The decision declaring the Virginian law unconstitutional was unequivocal evidence that laws excluding persons from a fishery on the basis of residency were discriminatory. The first sentence in Standard Four from the FCMA clearly prohibits this kind of blatant discrimination.

43FCMA Sec. 301 (a)(4). National Standards for fishery conservation and management.

INDIRECT DISCRIMINATION

However, disrimination is not always as easily identified if the statute does not explicitly exclude fishermen on the basis of residency. For example, there is a law in Maine that prohibits lobster fishing on Sunday. Both part-time and commercial fishermen are included in the law, but the effect is to make it impossible for an out-of-state weekend fisherman to tend his traps. The part-timer is effectively excluded, and the commercial operator is hardly even inconvenienced.

The uneven management burdens caused by fisheries management plans in the Northeast is not explicitly based on the residency of the fisherman. However, fishermen are affected differently because of their geographic location or residency. The differential economic impact of closures between residents of different states is severe.

In order to address this issue on a statistical basis, the catches of fish were collected on a monthly basis for thirteen years prior to the FCMA. The important species were assumed to be cod, haddock, and yellowtail, because they are the first groundfish to be regulated under the FCMA. Although these species do not migrate over thousands of miles like birds, fishermen have found that each species has a harvesting season for each

geographic area. Any management technique which interfered with the harvesting season in one state and not in another would cause an uneven management burden.

COD FISH CYCLES

For instance, the harvest of cod fish occurs in monthly cycles which are out of phase between the states of Rhode Island, Maine, and Massachusetts. The average percent of yearly harvest for each month shows this cyclic effect (figure twenty). The phases of these monthly cycles become important when fishery regulations imposing quotas or closed seasons are considered for inclusion into management plans. If the cod catch is closed in March, the Rhode Island fishermen would be cut off from their most productive cod fishing for the year. If the closure were to occur in June, the Maine fishermen would be excluded from one of their best fishing months. Although Massachusetts accounts for eighty six percent of the total cod fish caught in the New England area, the importance of the catch to the Maine and Rhode Island should not be underestimated (figure twenty-one).

Regulation by quotas would also have serious detrimental effects on the fishermen from Rhode Island and Maine. Because of the cod fish cycles, the catches of cod are highly variable between the states (figure twenty). This means that if quotas set daily catch or trip limits on the fishermen, the state where the fishing is seasonal will not be able to catch enough fish during the season to

average with the off-season catches. The average revenue from cod in Maine and Rhode Island would be significantly lower so these fishermen simply could not compete with the Massachusetts fishermen. This problem is not as serious for the Massachusetts fleet because fishing for cod is more constant there. Even the practice of weekly quotas will not correct the system's inequities between the states.

The economics of cod fishing in Maine and Rhode Island indicate a double penalty. First, because the fishermen cannot fish for large catches in season, the average catch per day is reduced. This means the fish must sell at a higher price if the fishermen are to survive. However, it is clear from the pie chart (figure twenty-one) that fishermen from Maine and Rhode Island receive less for their fish than their counterparts from Massachusetts. Regulation by quotas or closed season will have a greater economic impact on Maine and Rhode Island fishermen. Maine's fishermen depend on a larger percentage of their catch being cod than those fishermen from Rhode Island, so Maine's fishermen are at an even greater disadvantage when quotas or closures occur.

Of the three other categories of management techniques, increases in the average fixed cost or average variable cost do not discriminate between residents of different states because their action is primarily an economic one and does not depend on harvest rates. The

management techniques that only affect the industry revenue and cost curves, such as closed areas, do not differentially impact these states. This is because these techniques do not control the number of days fished or the amount of fish caught by a vessel during any part of the season. In other words, a fisherman can fish as long and as hard as he wants without interference provided that he is not fishing with a small mesh or in a closed area.

HADDOCK CYCLES

The differential impact between residents of different states due to cycles in haddock catches is different from cod because the prices of haddock are higher for the states with the highest variability in catches and the phases of the seasons are different (figure twenty two). The same problem exists for haddock which was discussed for cod; that is, if closed seasons are used to regulate the fishing industry, there are differential impacts between residents of different states.

Again, Maine and Rhode Island are the states that would be impacted more than Massachusetts. Examination of the pie charts in figure twenty three indicates that Maine will be more severely impacted than Rhode Island. The quotas on haddock also prevent the Maine and Rhode Island fishermen from catching the large hauls which are necessary to average with the losses in the off season.

YELLOWTAIL CYCLES

Yellowtail flounder are caught primarily by Massachusetts and Rhode Island fishermen within the data collection area. Even though the Maine catch is graphed in figure twenty four, the thirteen year average catch for Maine was less than one half of one percent (figure twenty five) and the Standard deviation is greater than the mean for the percentages caught. This means that when Maine fishermen catch yellowtail it is highly unusual and not an important part of their fishing revenue. When the catch curves for Massachusetts and Rhode Island are compared, they are very similar. Therefore there would be no serious differential impacts between these states if the yellowtail regulation included quotas and closed seasons. However, yellowtail are very seasonal in New York and New Jersey and these states were not included in the data base for this thesis, so discrimination from quotas or closed seasons can not be proved or disproved for these states.

ECONOMIC HARDSHIP

It is evident that fisheries regulations that use quotas and closed seasons do cause an uneven management burdens on fishermen which is more severe in some states than others. Careful examination of the legislative history of the FCMA helps to clarify whether or not the second half of Standard Four prohibits this type of discrimination.

DISTINCTION BETWEEN RESIDENTS

Discrimination is defined as a distinction, made in

favor of one person or group over another. In order for discrimination to exist, some form of distinction must be made between the fishermen in the region. In his report of the Senate Committee on Commerce, Senator Magnuson states "since there will be pressures on the state representatives to protect the residents of their home state, nothing will destroy the effectiveness of this new management program more than if one state, or group of states, attempts to favor their own residents to the detriment of others."45 Senator Magnuson saw that even though the fishermen fish the same stock of fish, the political grouping of people into states distinguishes fishermen.

UNJUST DISTINCTION

The definition of discrimination also states the distinction must be unjust. "Just" is defined as morally right or good, and having a basis in or conforming to fact or reason. Unjust must be the inverse of just, or not morally right or good, and not having a basis in or conforming to reason. Senator Magnuson gave the following hypothetical example which he felt was discriminatory:

> "If, for example, the most efficient area to catch fish during their migration is near the coast of Rhode Island, New Jersey fishermen should be allowed an equitable portion of catch if they also fish the same stock."46

In both Magnuson's example and the case of quotas or closures, the inequities are caused by the migration of fish, the fishermen are distinguished by their residence

in different states, and they are harvesting the same stock of fish. In the view of Senator Magnuson, an unjust distinction between residents like a closure or a quota which caused uneven management burdens based on residency is discriminatory.

CONCLUSIONS

The objectives which are chosen for the fisheries management plans will be affected by the politics of the institutions involved in the management process. Special interest groups represented on the Regional Councils will affect the determination of the Optimum Yield. It has been shown that imprecise data collected and presented by the NMFS has affected the OY because the concept of MSY was interpreted to mean a minimum brood stock.

It has also been shown that quotas and closed seasons prevent some fishermen from harvesting their traditional share of fish. It has also been shown that, although this is an unintentional side effect of management through quotas and closures, it could be avoided by using a different management technique such as random closed areas. Therefore, regulation by quotas and closed seasons constitutes an unjust and avoidable distinction between residents of different states. Simply put, quotas and

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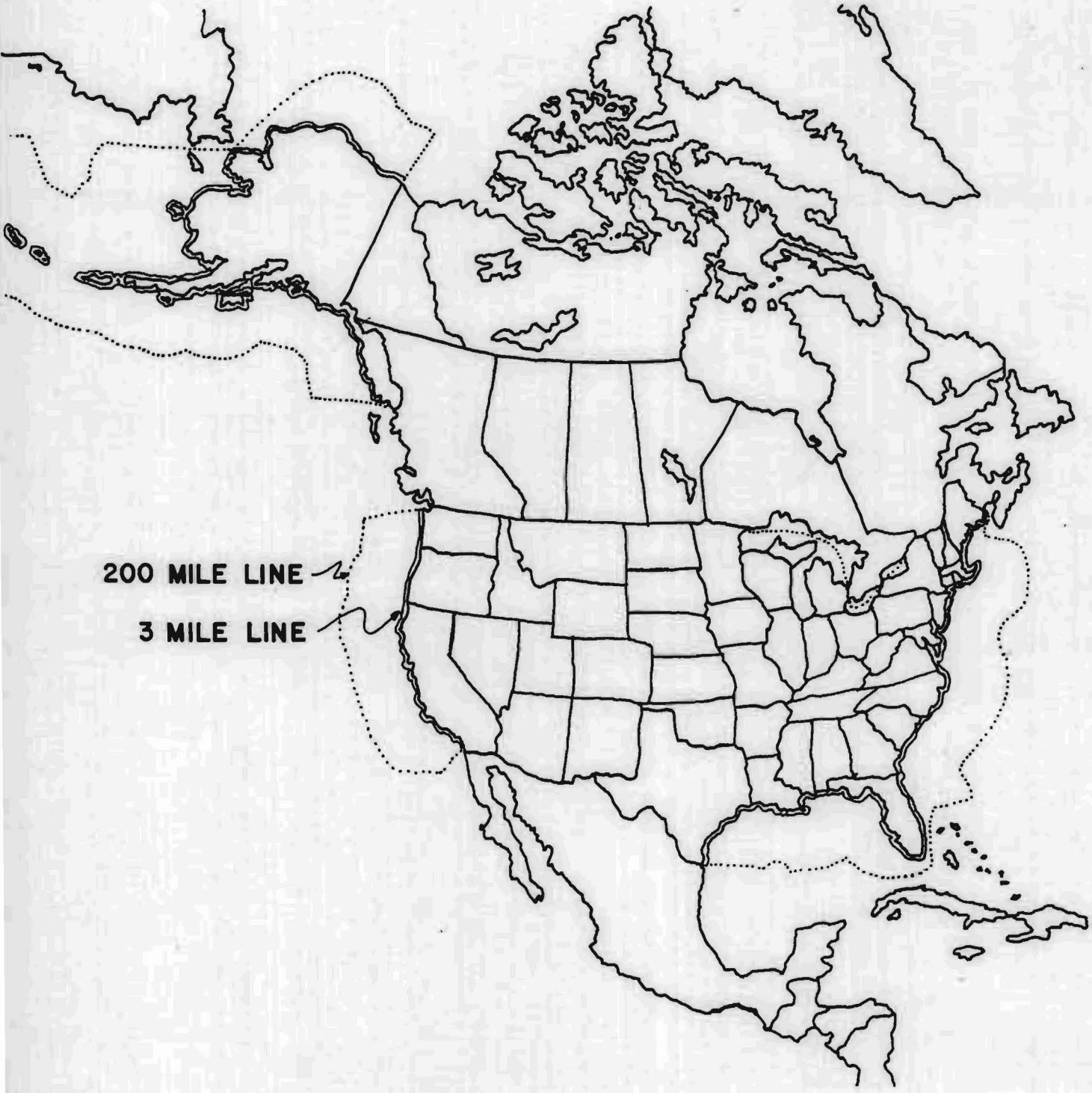
45Legislative History. p. 686.

46Ibid. p. 686.

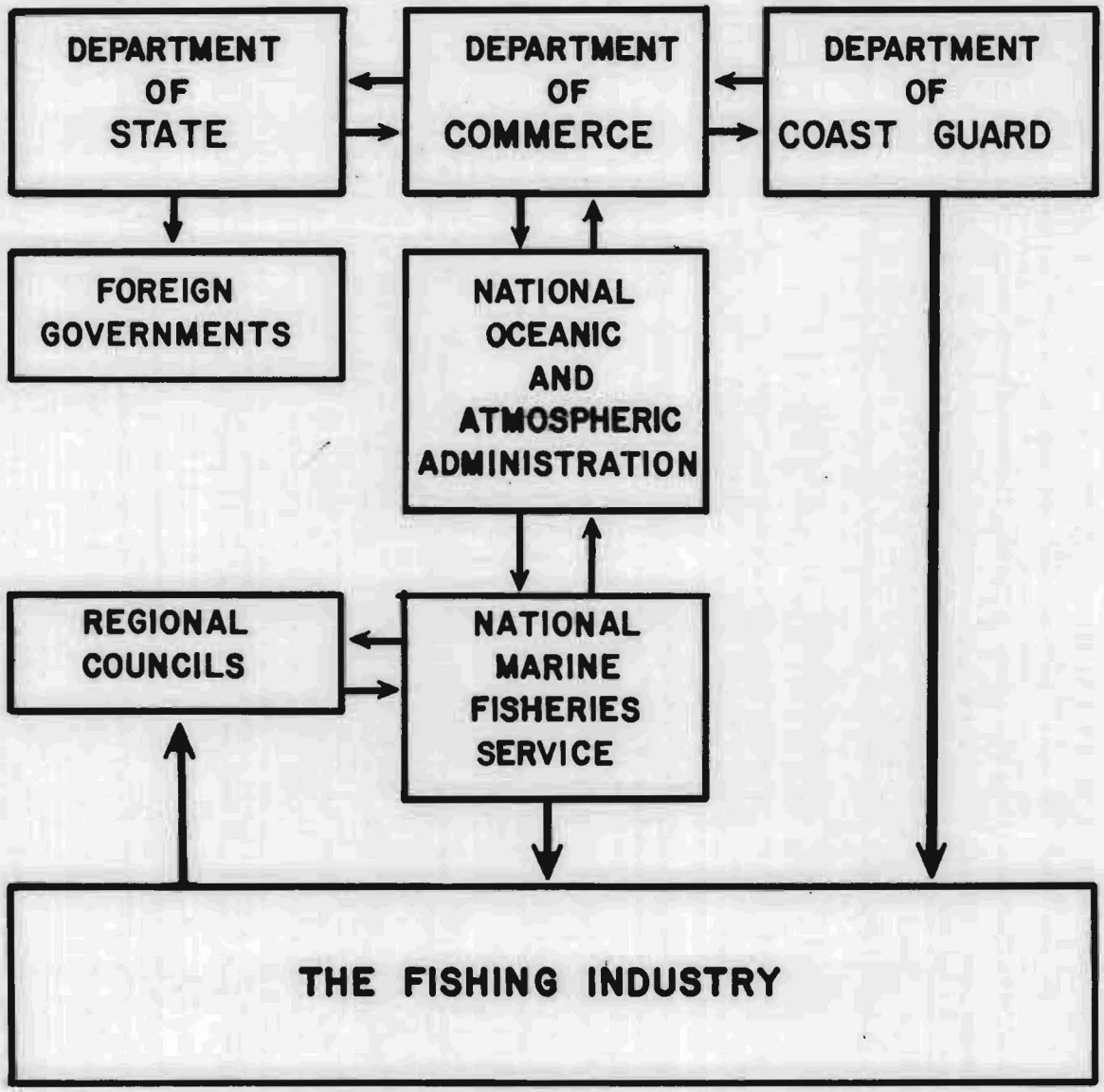
closures discriminate against fishermen on the basis of residence which is explicitly prohibited in Standard Four.

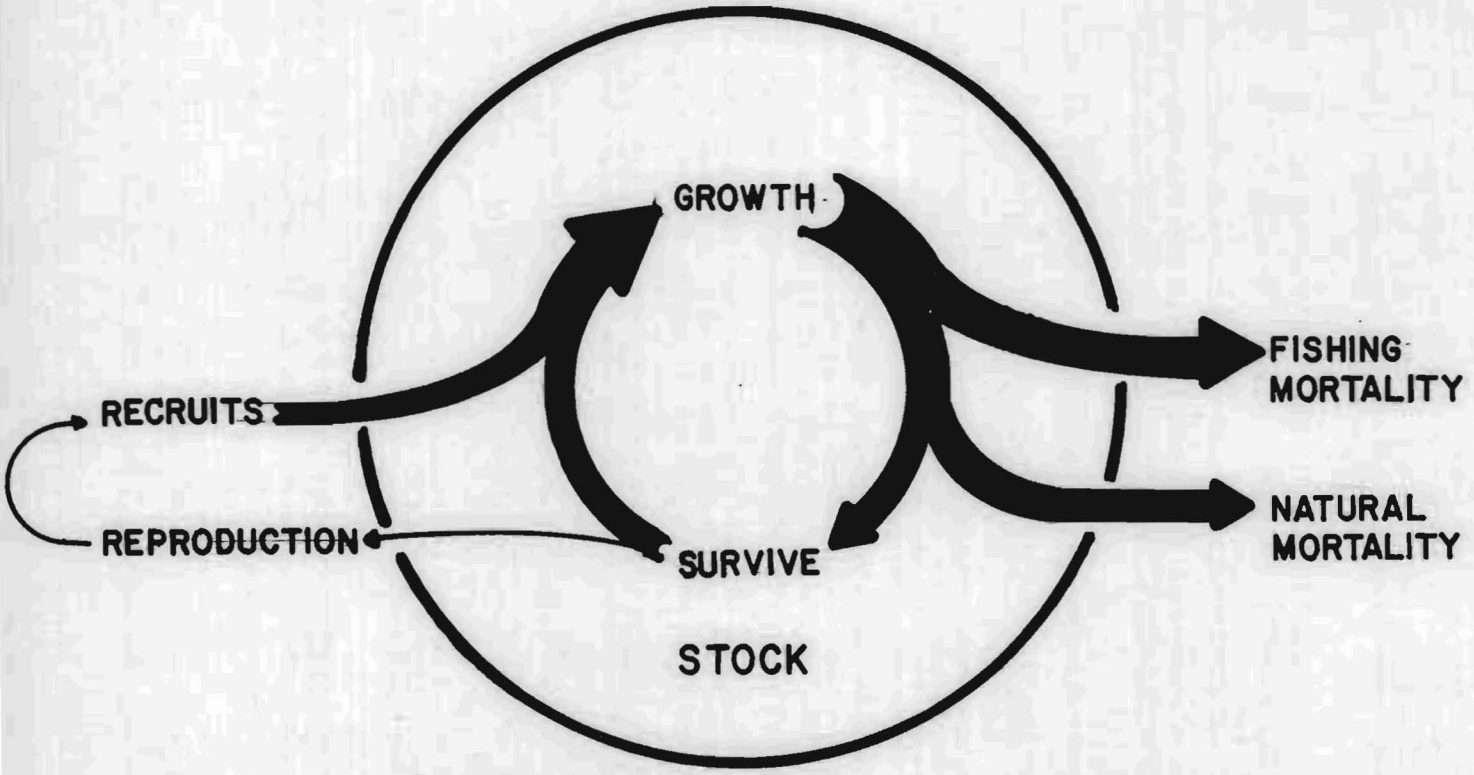
The Regional Councils have consider uneven management burdens when they deliberate the pros and cons of each management technique but there has been no concensus on how they affect fishermen. Although legally speaking only the blatant discrimination such as that in the Douglas vs. Sea Coast Products can easily be proven unlawful, the second half of Standard Four indicates that the allocation process may produce undesirable or inequitable side effects which should be avoided if possible. In all but the industry catch per unit effort category the variation in harvest seasons between states cause uneven burdens or discrimination between residents of different states or have other undesirable secondary effects. Therefore, fisheries management should rely upon management techniques like random closed areas and mesh regulations if uneven burdens are to be avoided.

U.S. FISHERIES CONSERVATION ZONE



WHO IS WHO IN FISHERIES

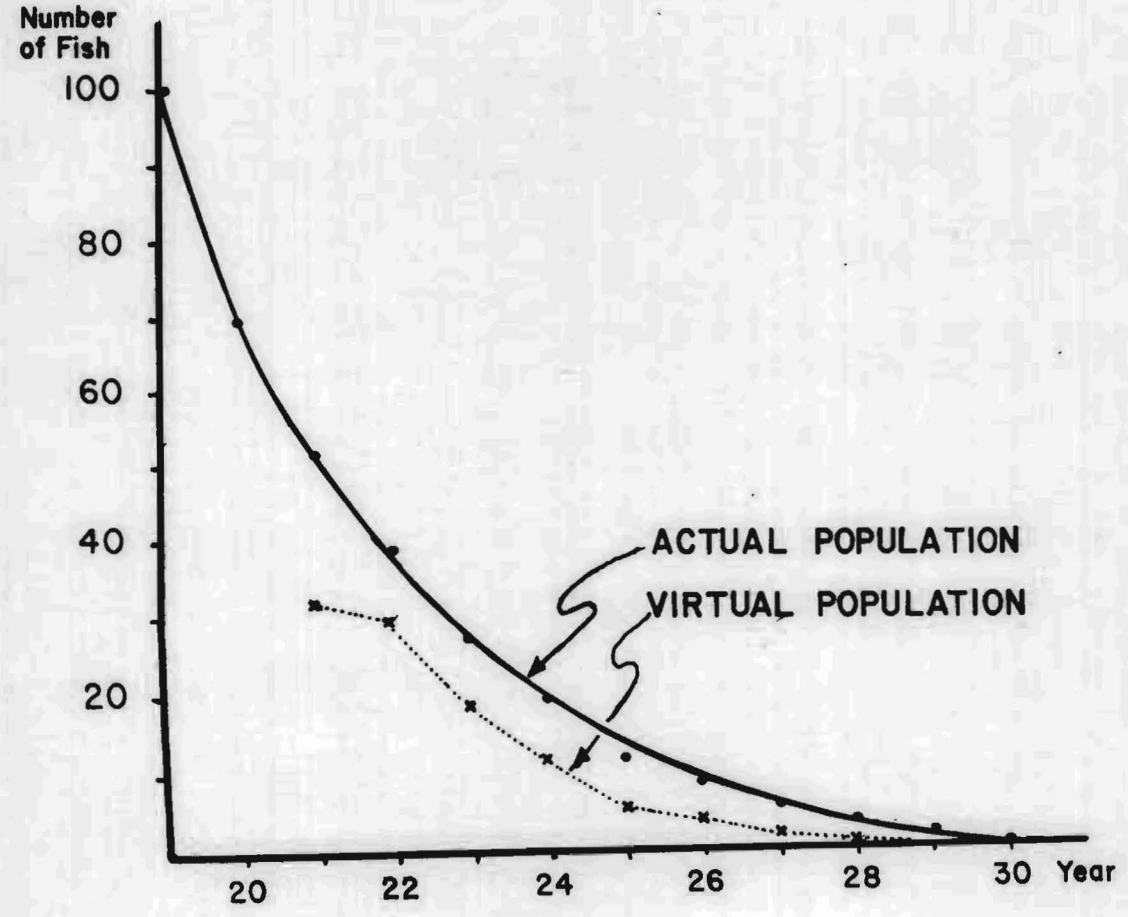


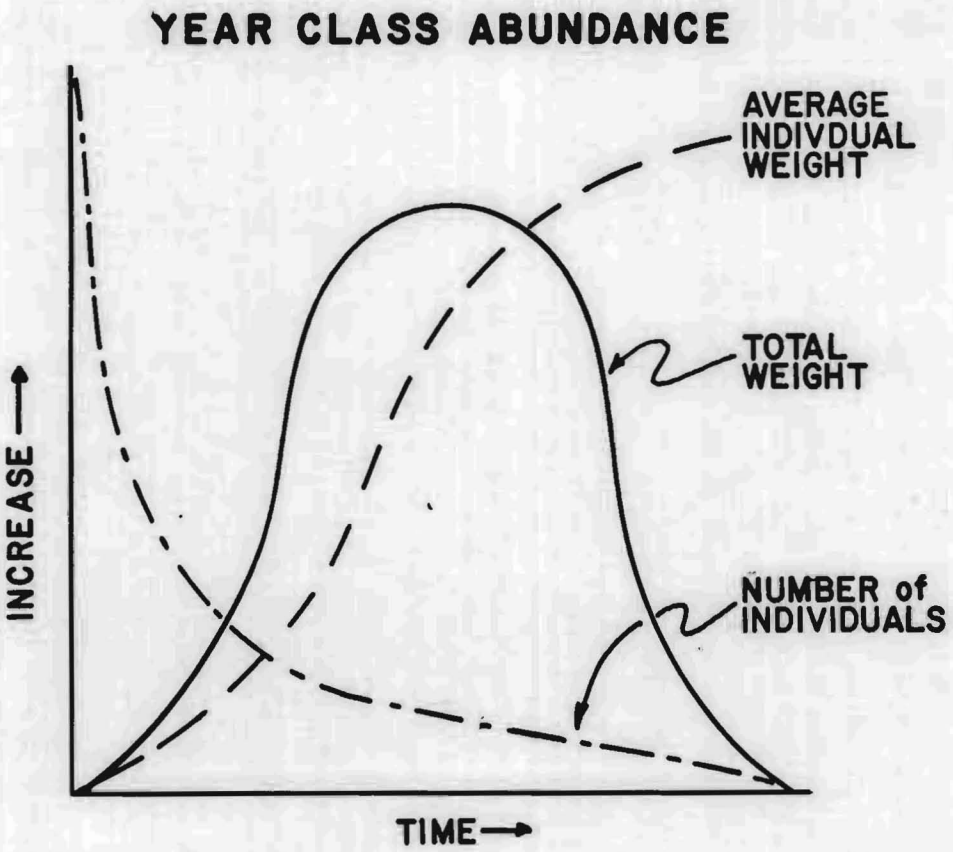


FISH STOCK CYCLE

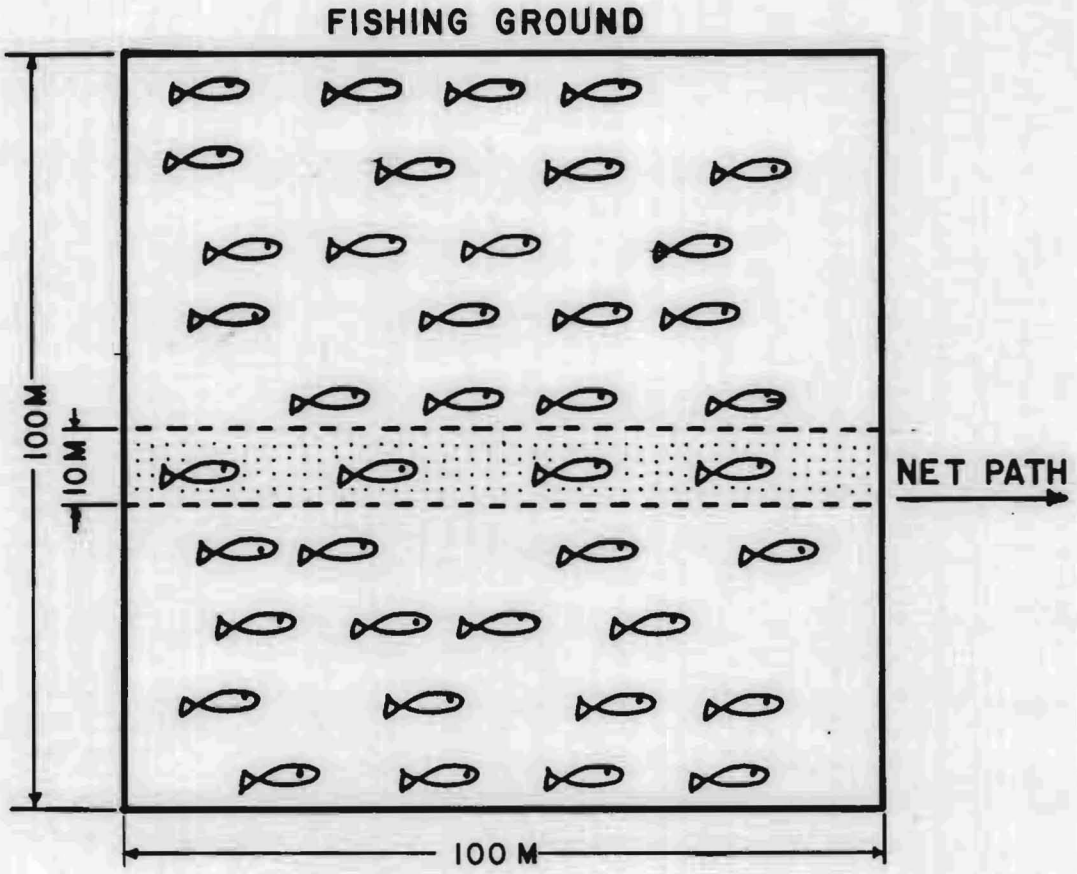
COHORT ANALYSIS on the fish CRAT 1920 year class

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930
AGE	1	2	3	4	5	6	7	8	9	10	11
LANDED	0	0	2	11	7	6	2	2	1	1	0
TOTAL	0	0	2	13	20	26	28	30	31	32	32
REMAIN	?	32	30	19	12	6	4	2	1	0	0




YEAR CLASS ABUNDANCE
AVERAGE INDIVDUAL WEIGHT
TOTAL WEIGHT
NUMBER of INDIVIDUALS
INCREASE
TIME

FISH STOCK ASSESSMENT
by AREA SWEPT CLEAN



STOCK = ?

NUMBER of FISH CAUGHT = 4

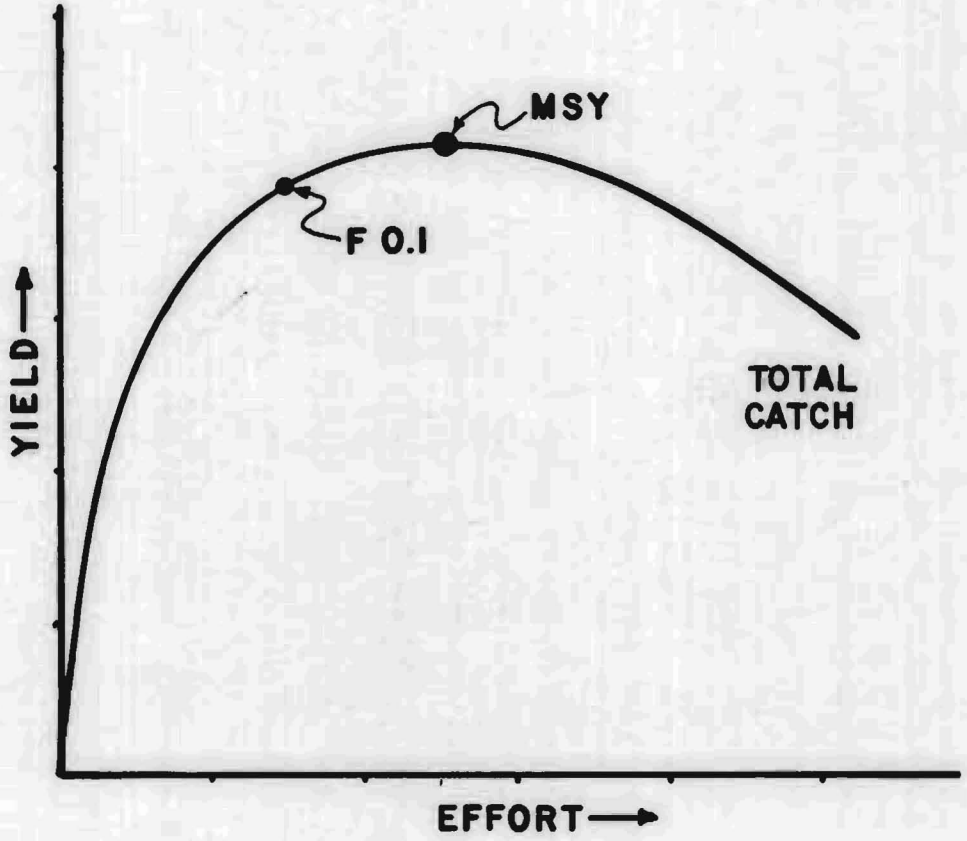
TOTAL FISHING GROUND = 10,000 M^2

AREA SWEPT CLEAN = 1,000 M^2

$$\text{STOCK} = 10{,}000 \times \frac{4}{1{,}000} = 40 \text{ fish}$$

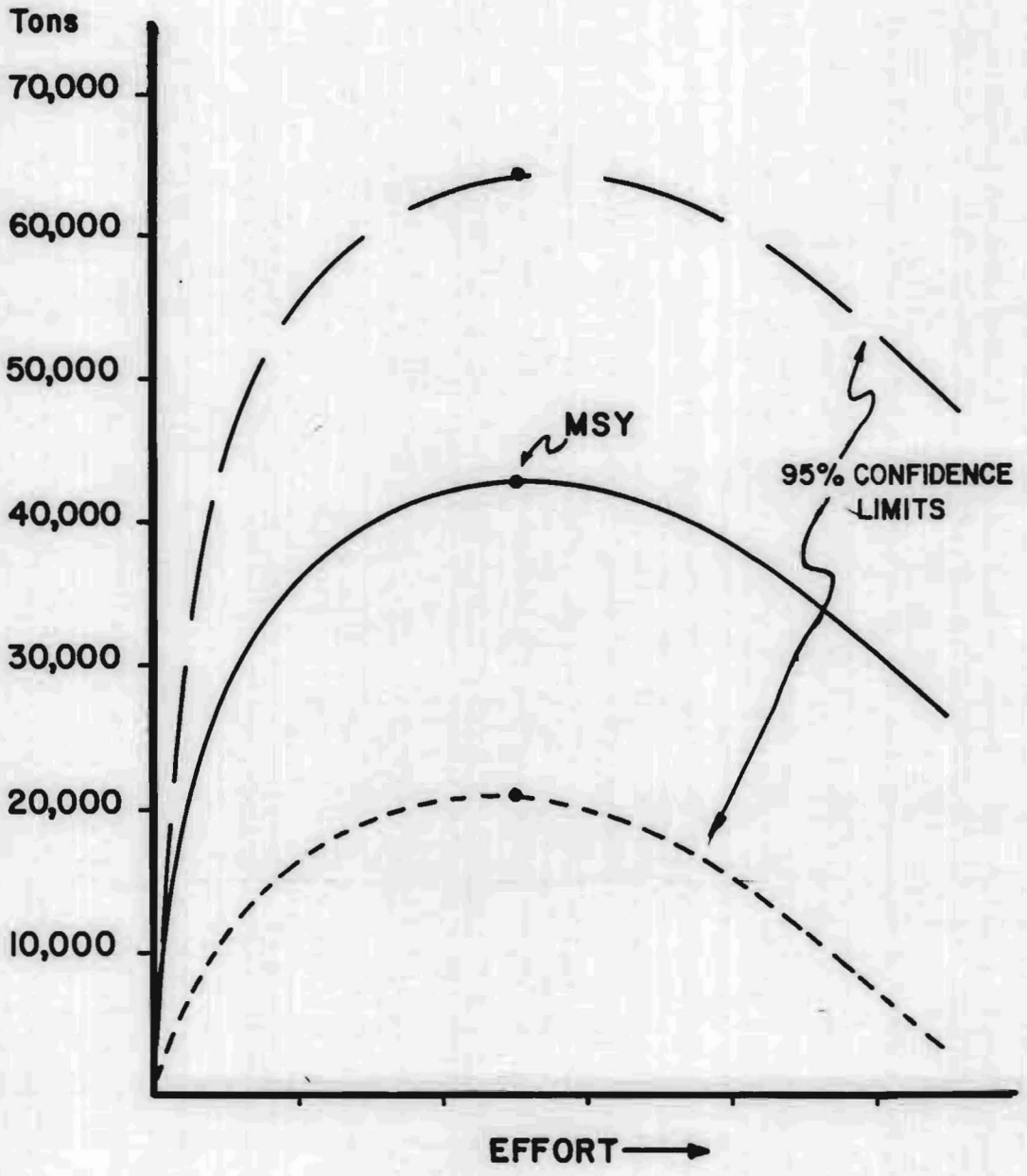
$$\text{STOCK} = \text{TFG} \times \frac{\text{NFC}}{\text{ASC}}$$

MAXIMUM SUSTAINABLE YIELD



MAXIMUM SUSTAINABLE YIELD

COD 5Y+5Z

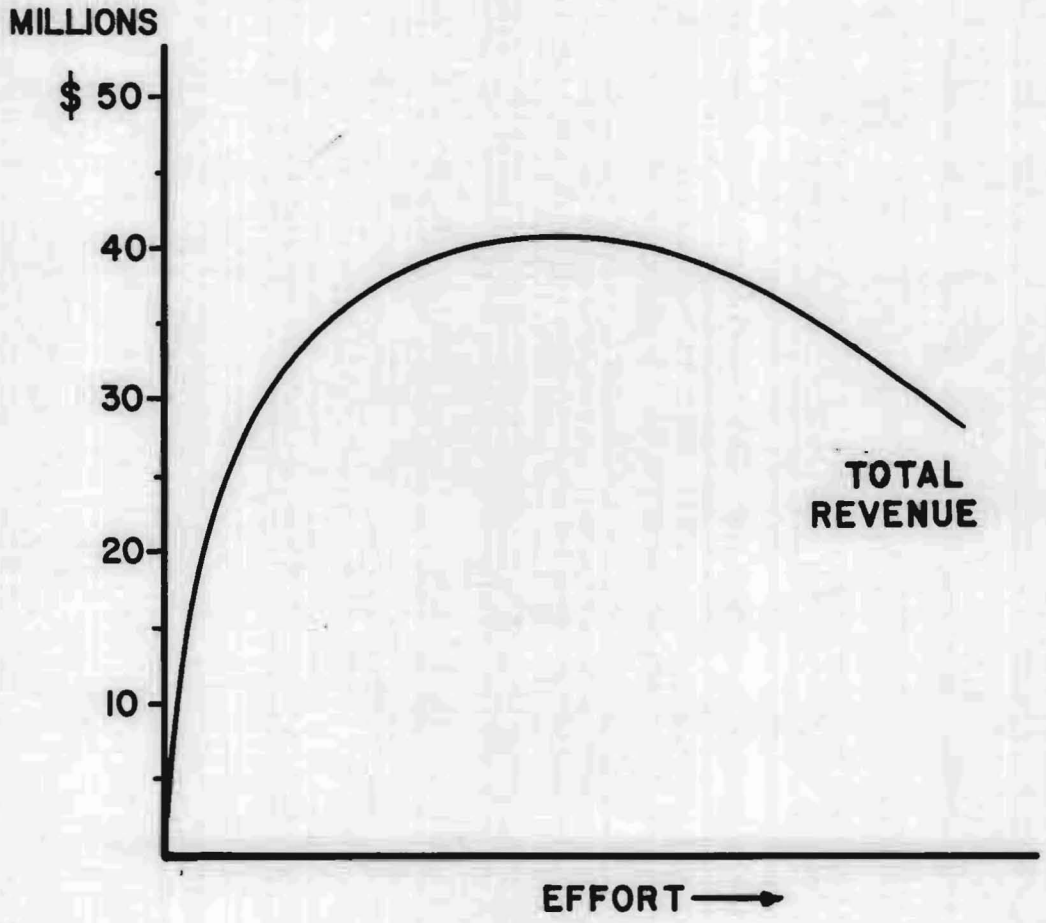


SOURCE: NMFS Woods Hole
Lab Ref. No. 76-05

INTRODUCTION OF ECONOMIC FACTORS.

GIVEN

CATCH PER UNIT EFFORT

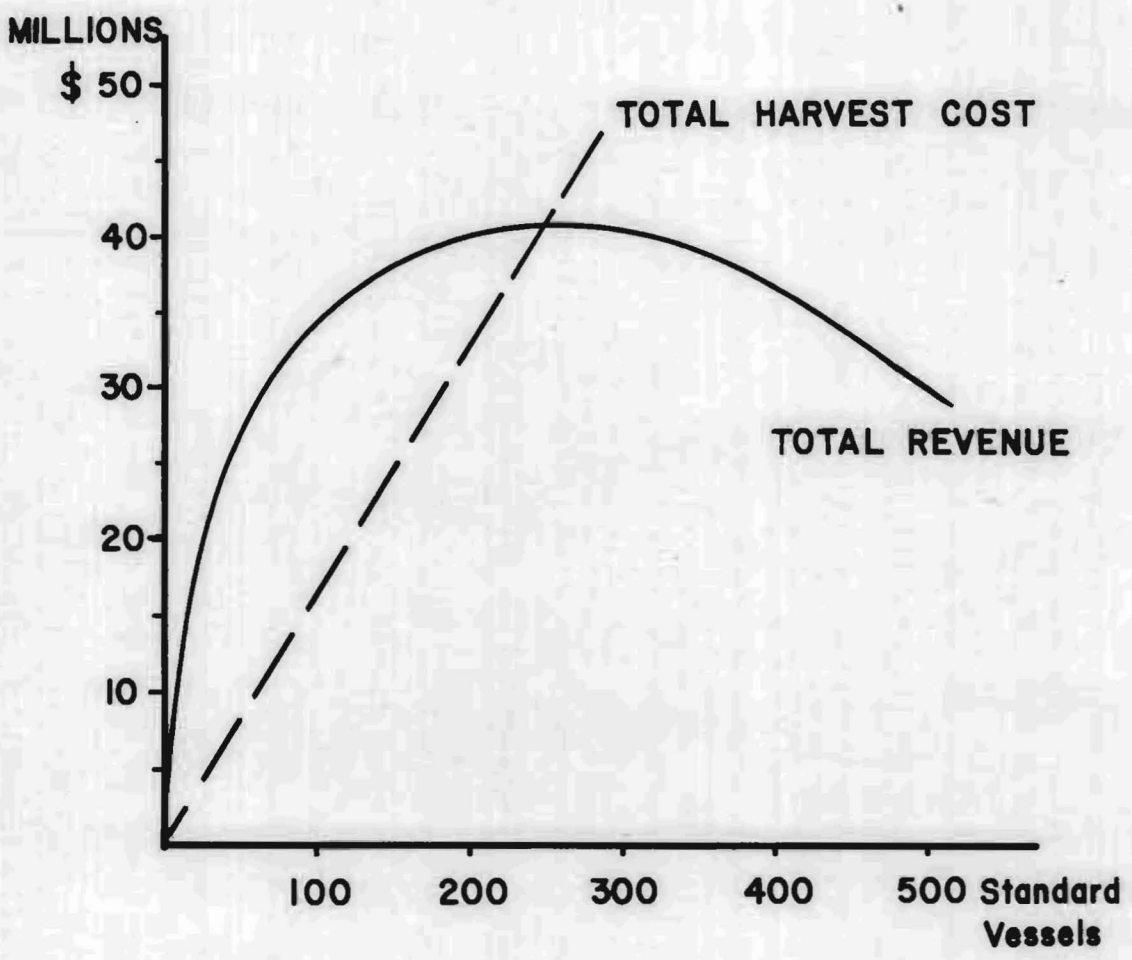


If an M.S.Y. of 43 thousand metric tons is given and 46¢/pound is the price, the maximum total return is $ 43,500,000.

INTRODUCTION OF ECONOMIC FACTORS.

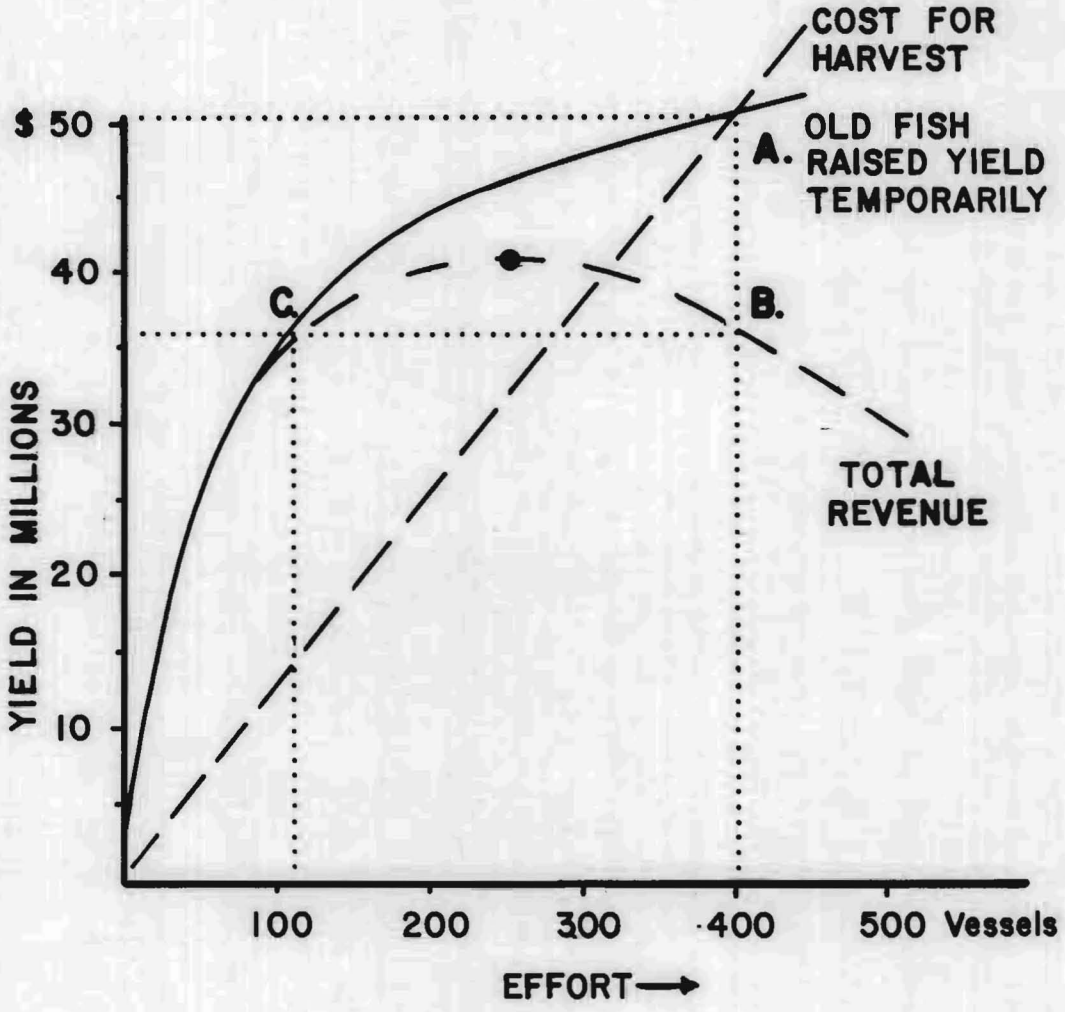
GIVEN

A VALUE PER UNIT EFFORT CURVE

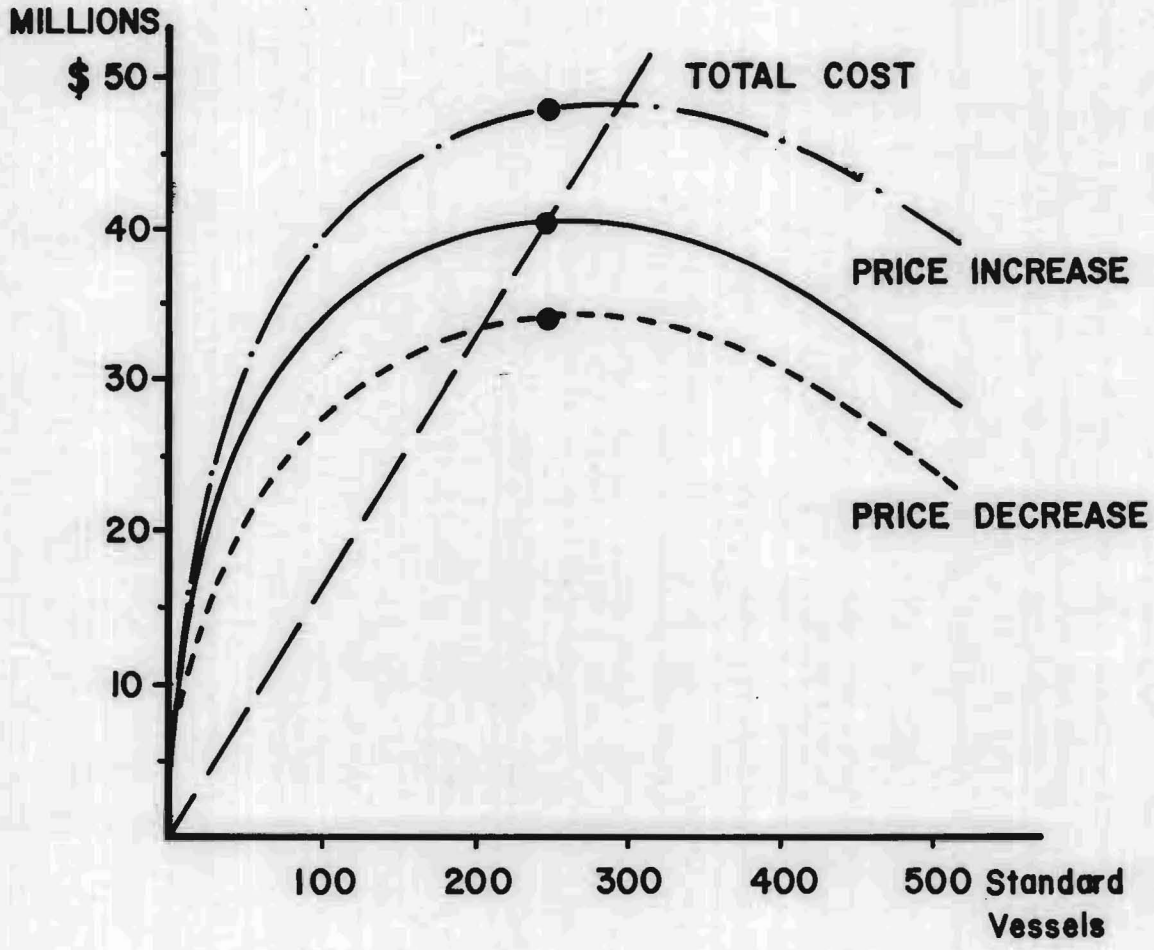


If the average cost per standard vessel is $174,000 then the cost of 250 vessels needed to harvest M.S.Y. is $ 43,500,000

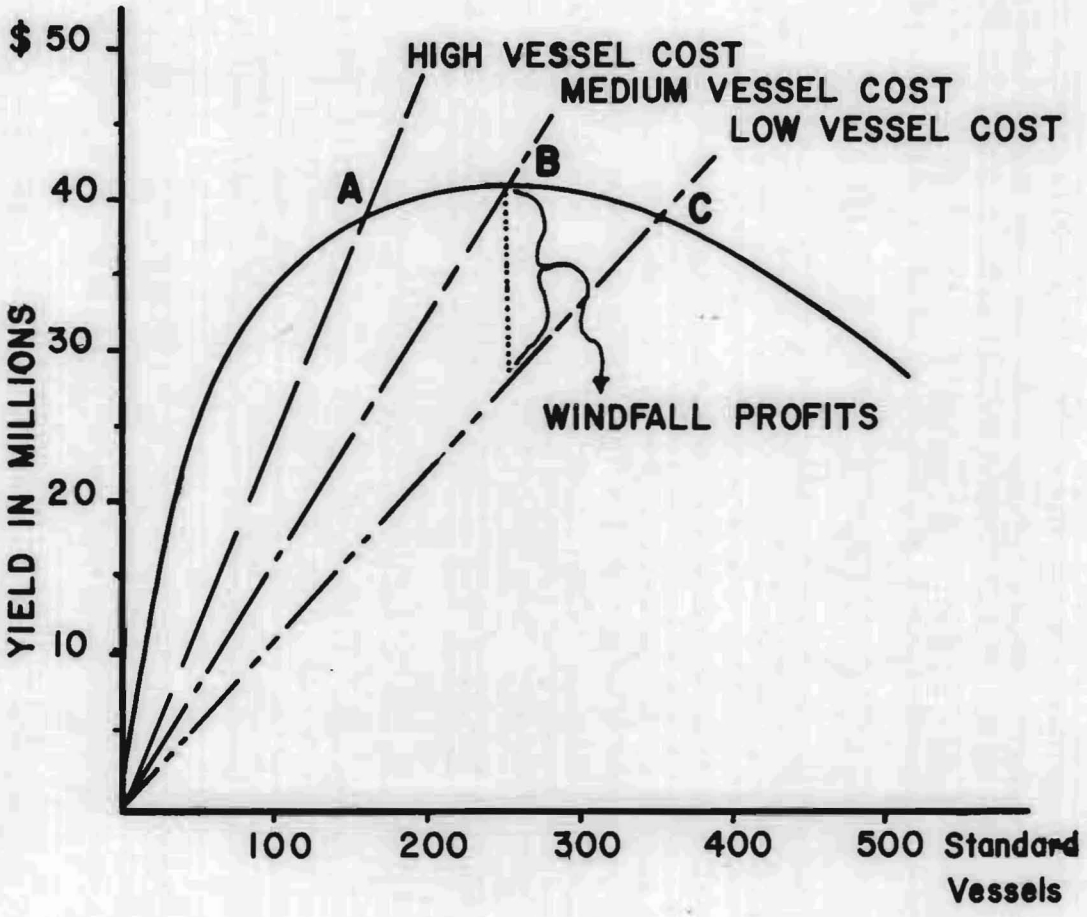
EXPLOITATION OF A VIRGIN STOCK



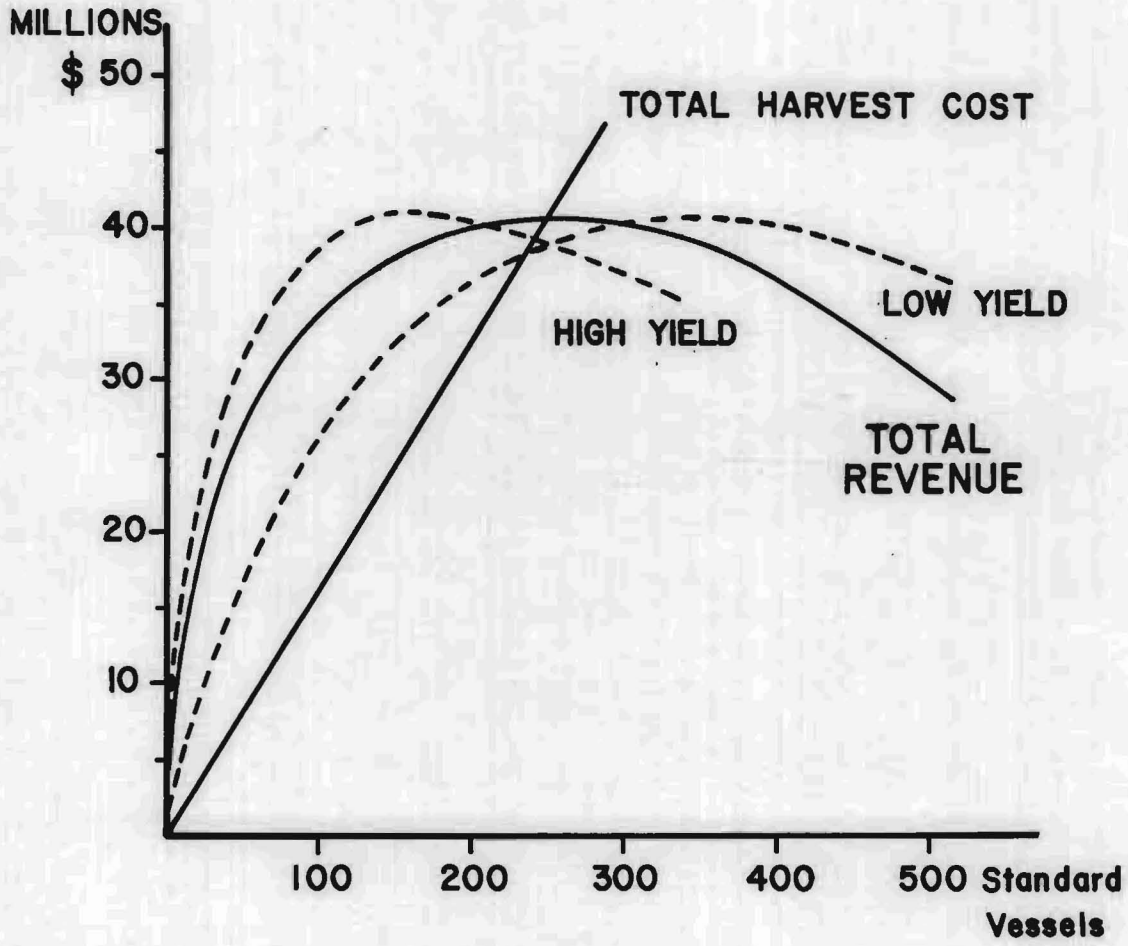
A CHANGE IN PRICE



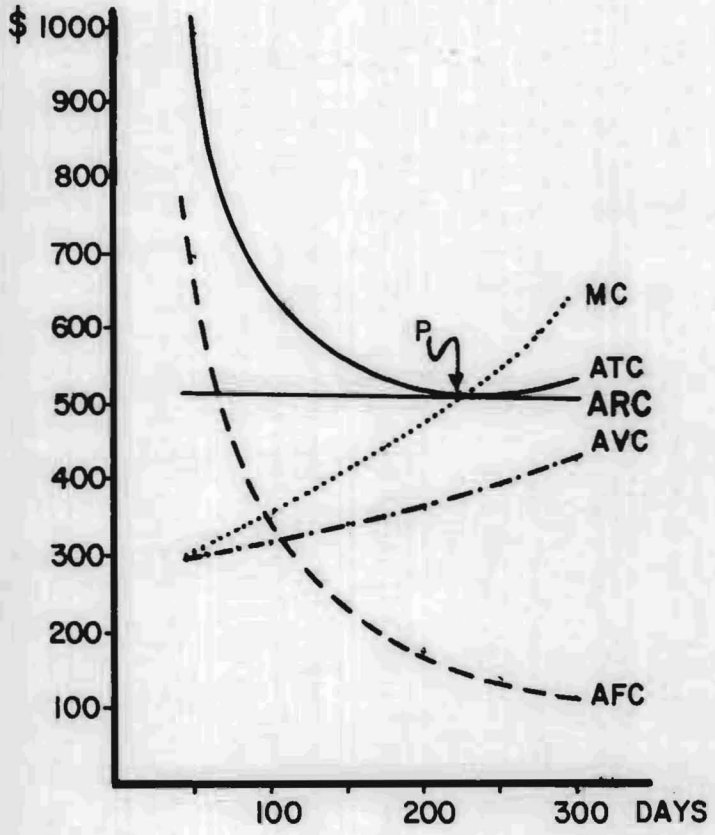
NEW COST CUTTING TECHNOLOGY



A CHANGE IN CATCH PER UNIT EFFORT



INTRODUCTION TO FISHING VESSEL ECONOMICS



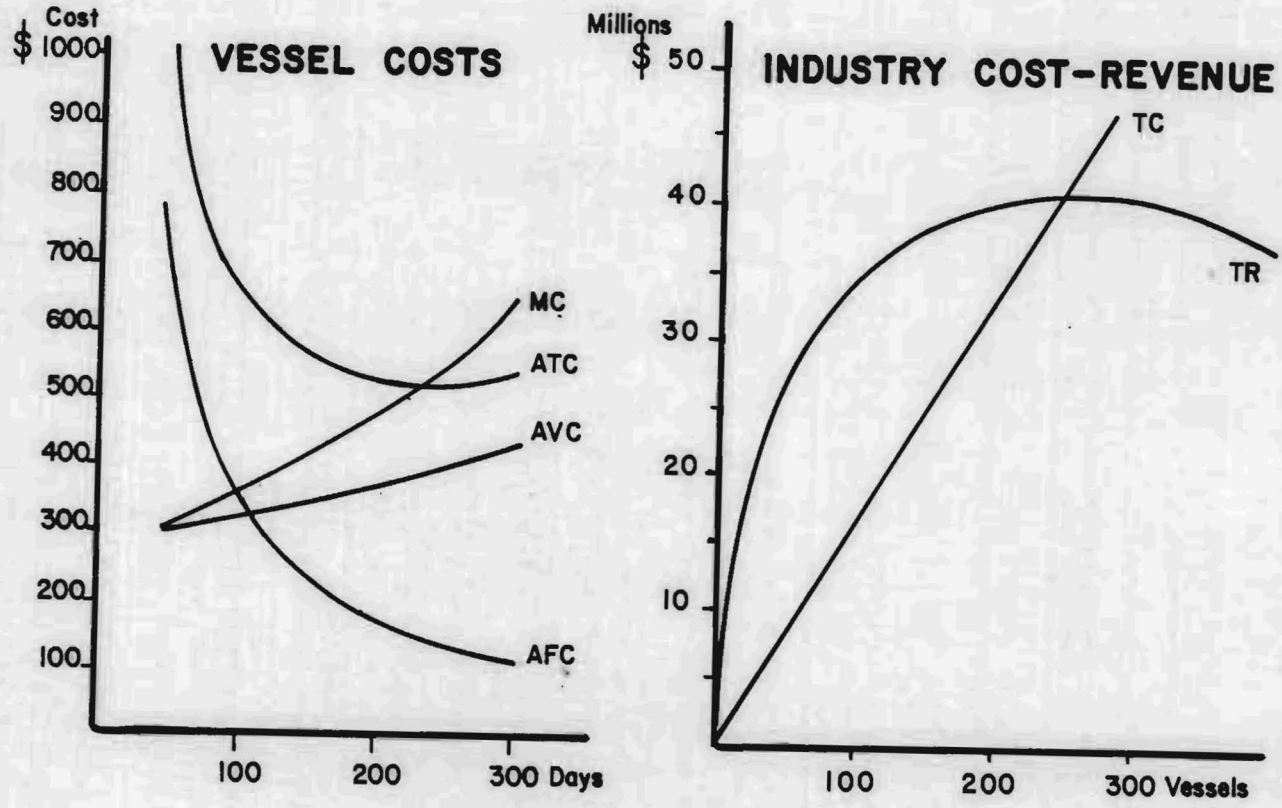
- A FISHING VESSEL HAS CONTROL OVER THE NUMBER OF DAYS FISHED.
- GROSS STOCK IS THE DAYS FISHED TIMES THE YIELD TIMES THE PRICE.
- LABOR IS 50% OF GROSS STOCK.
- THEREFORE THIS 60 FOOT VESSEL SHOULD FISH 225 DAYS AND NEEDS A DAILY GROSS STOCK OF $1020.*
- FISHERMEN FISH FOR MONEY NOT FISH.

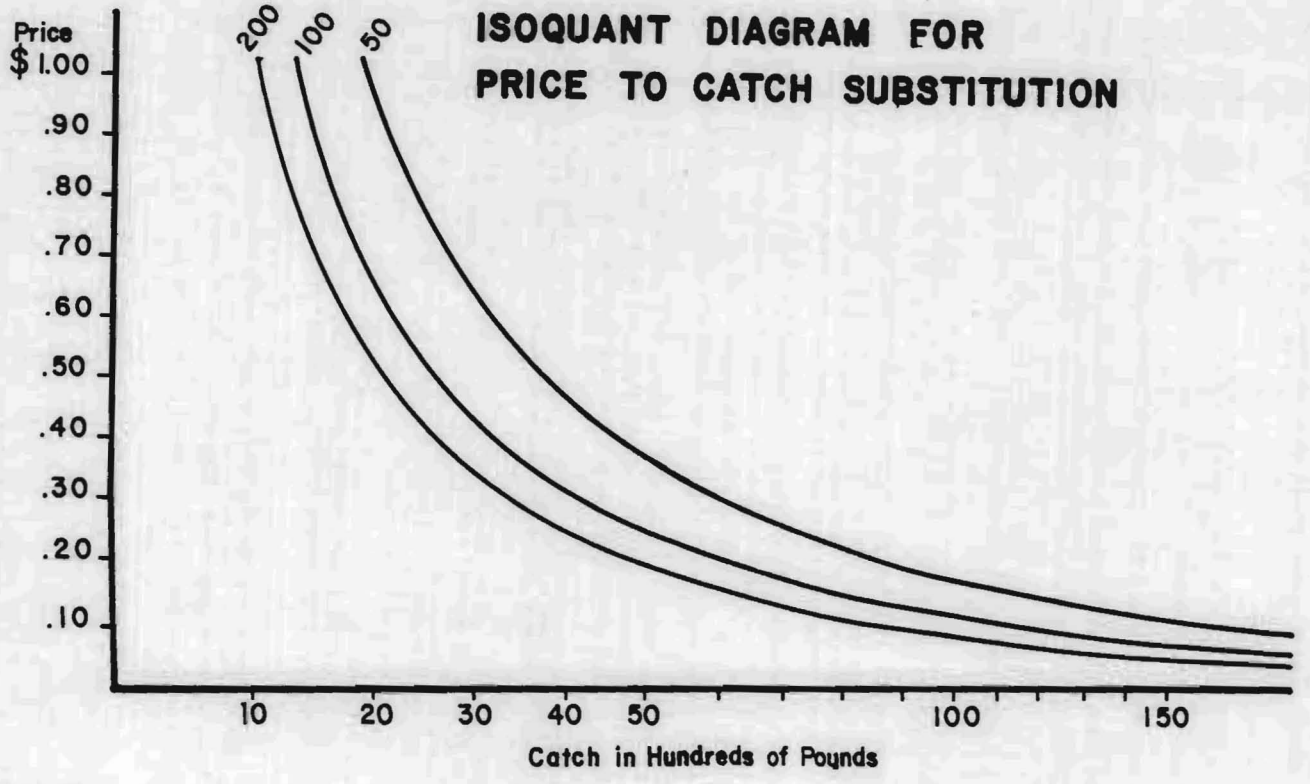
AFC = AVERAGE FIXED COST
AVC = AVERAGE VARIABLE COST
ATC = AVERAGE TOTAL COST = AFC + AVC
MC = MARGINAL COST = $\Delta TC / \Delta Q$
TC = TOTAL COST
Q = QUANTITY OF DAYS
ARC = AVERAGE REVENUE CURVE

* Assuming that the ARC intersects the MC and ATC at point P

Figure 14

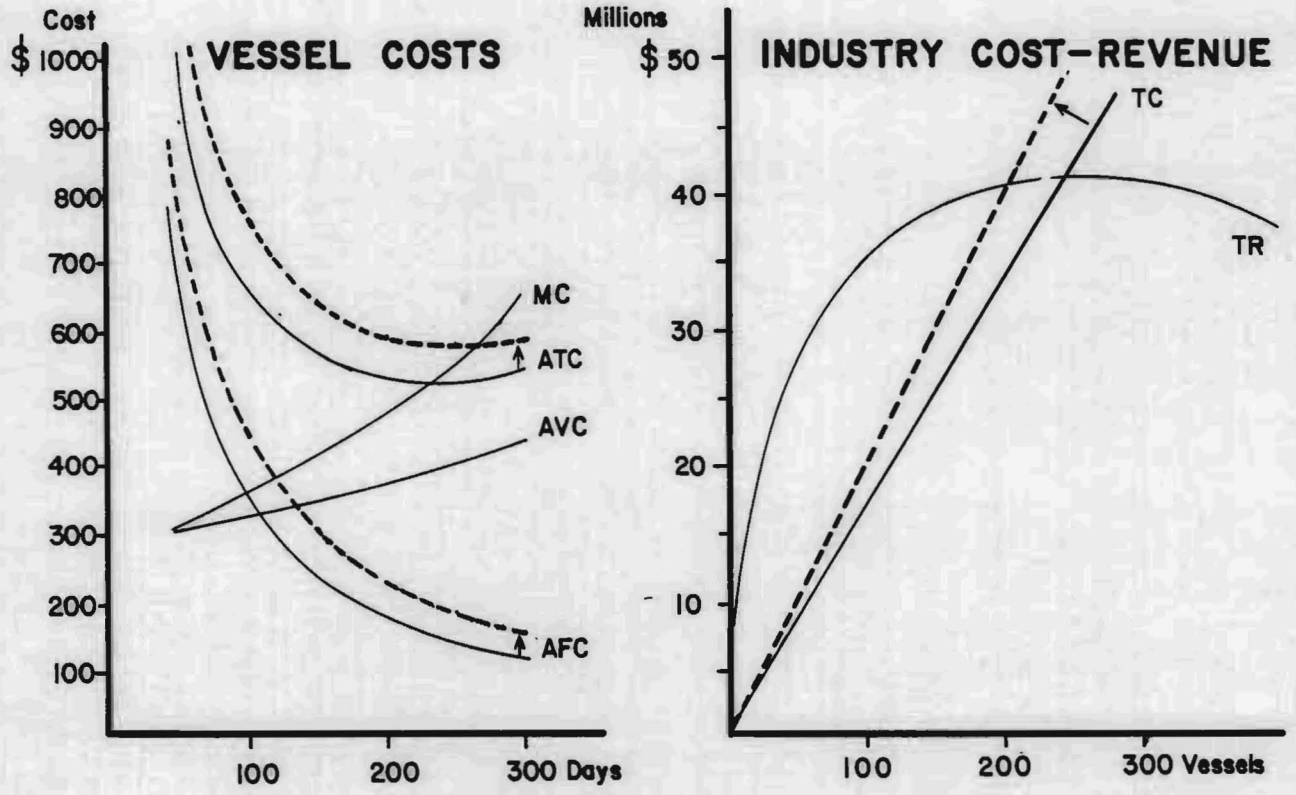
A FISHERY IN EQUILIBRIUM

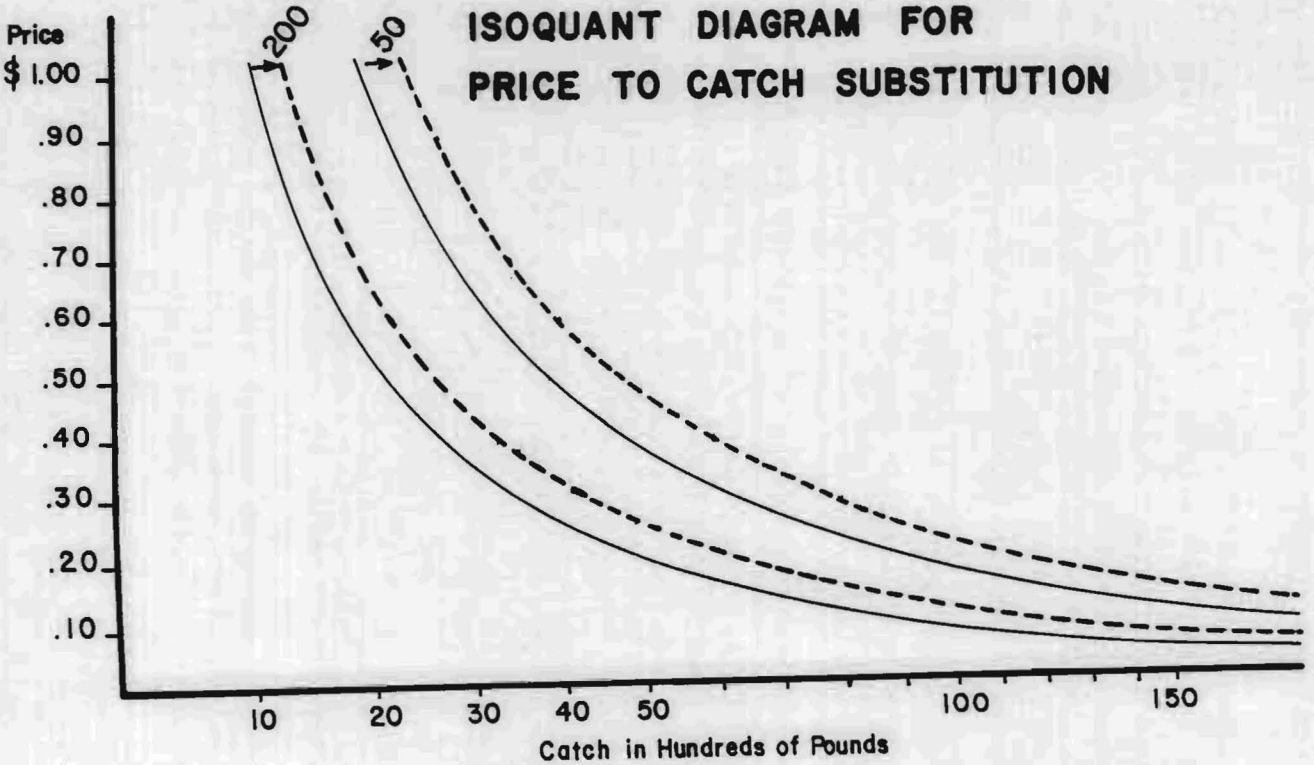




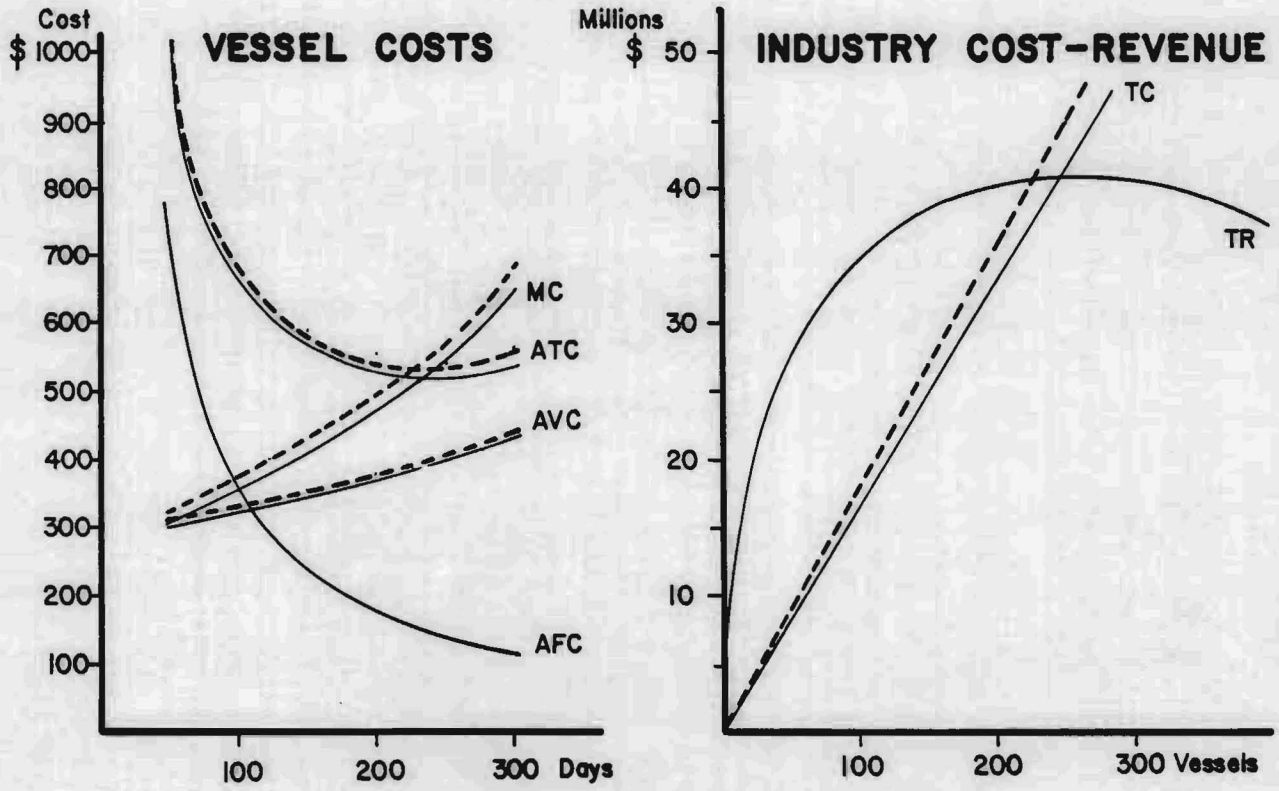
REGULATION BY PERMITS OR FEES

$10,000





REGULATION BY EFFORT TAX



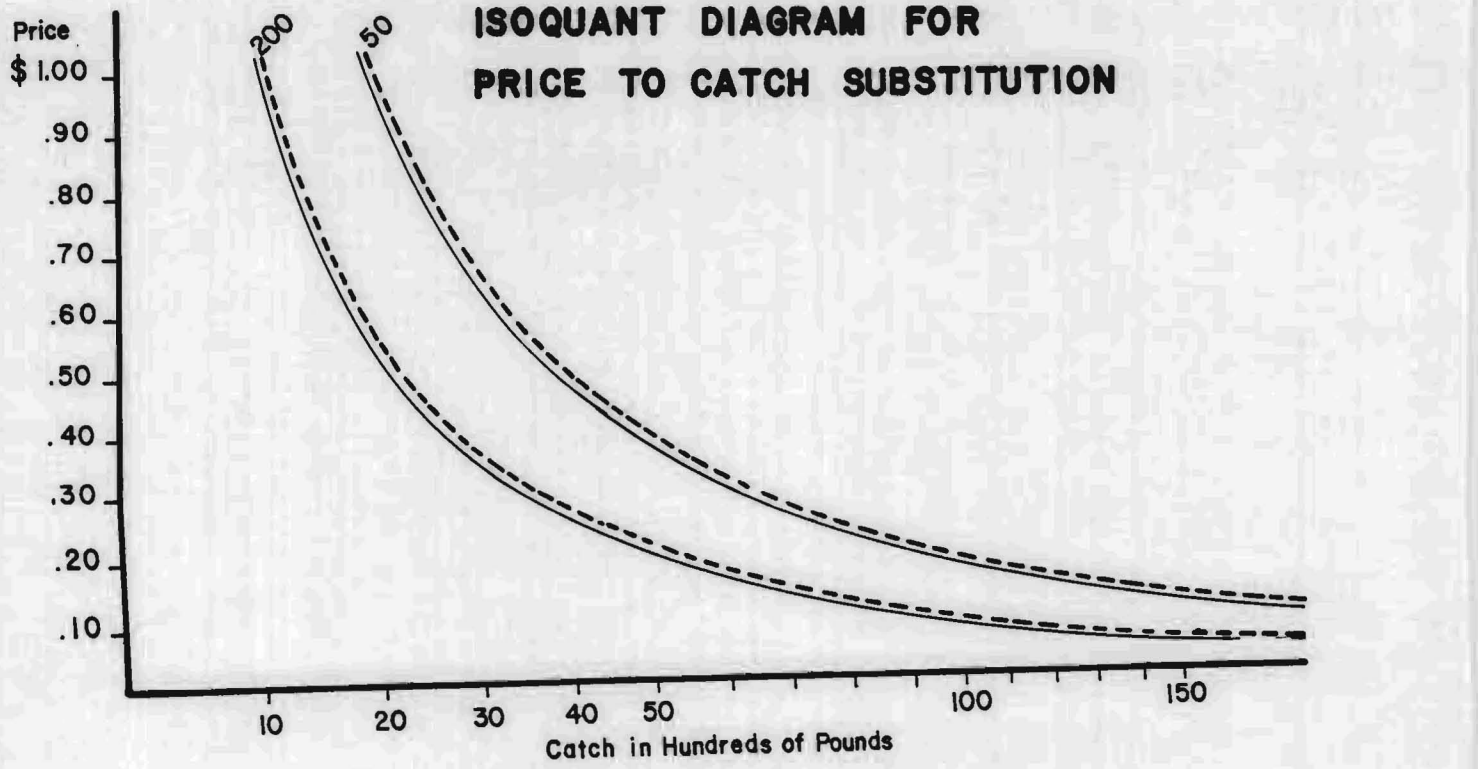
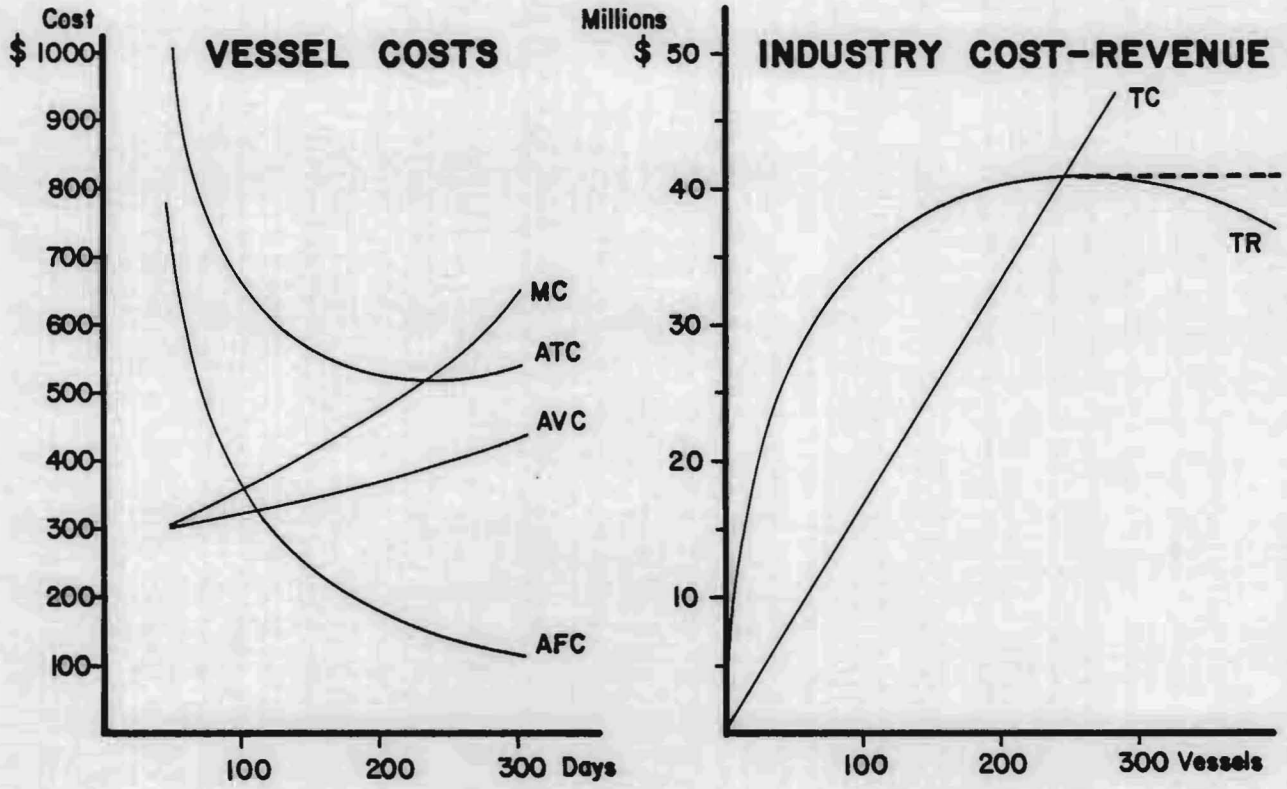
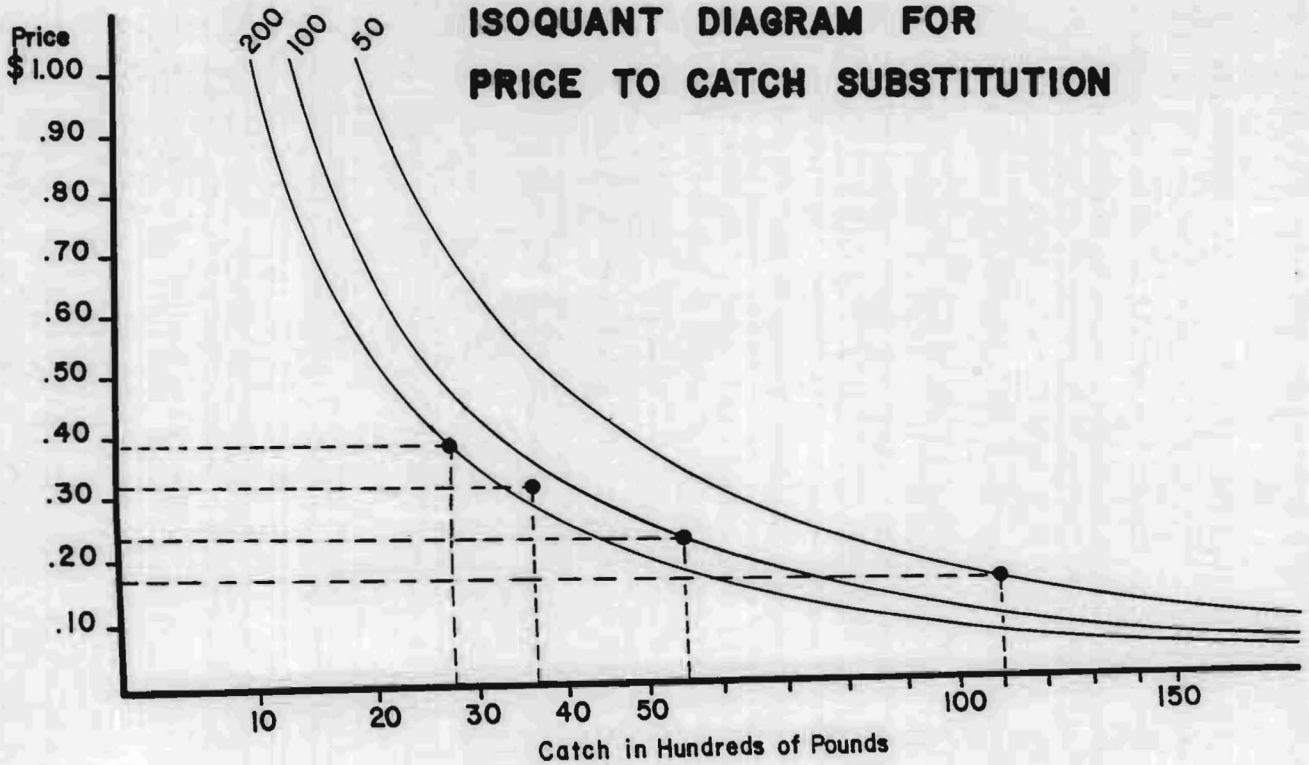


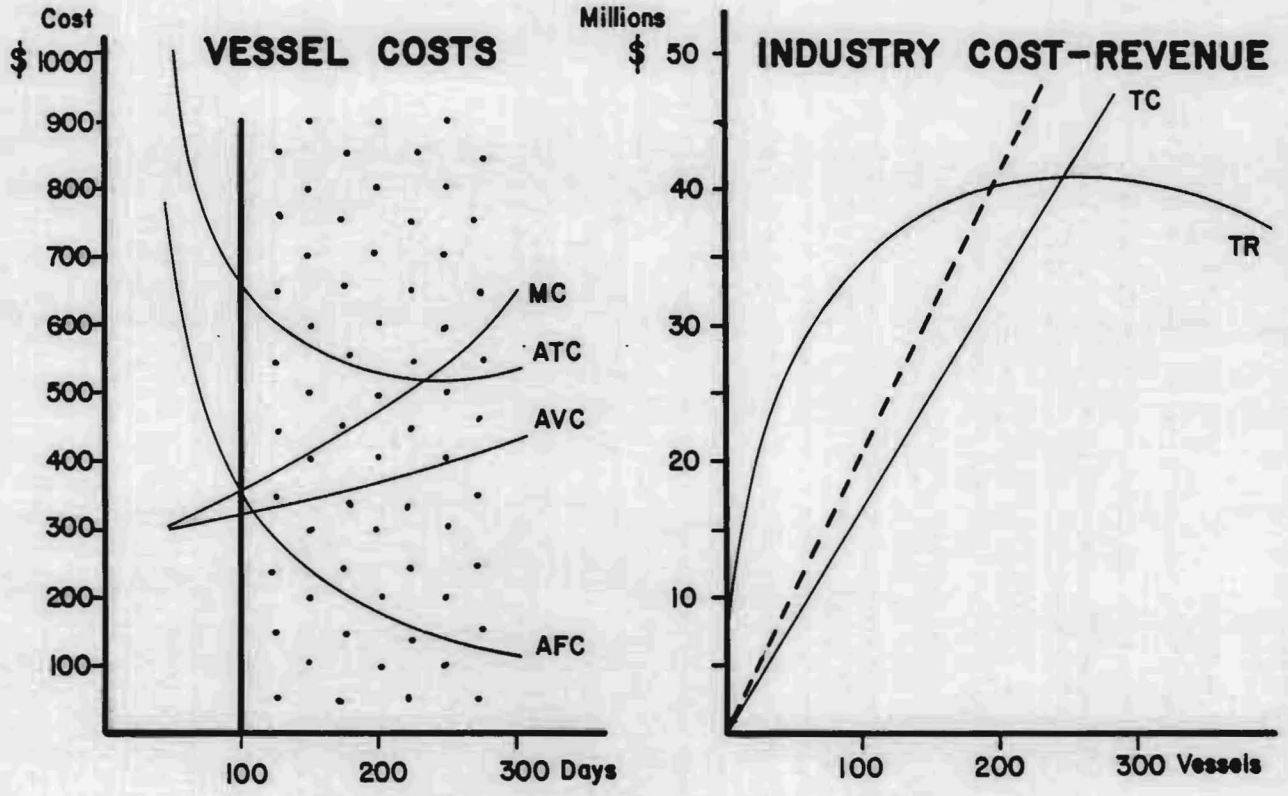
Figure 17

REGULATION BY QUOTAS





REGULATION BY CLOSED SEASON



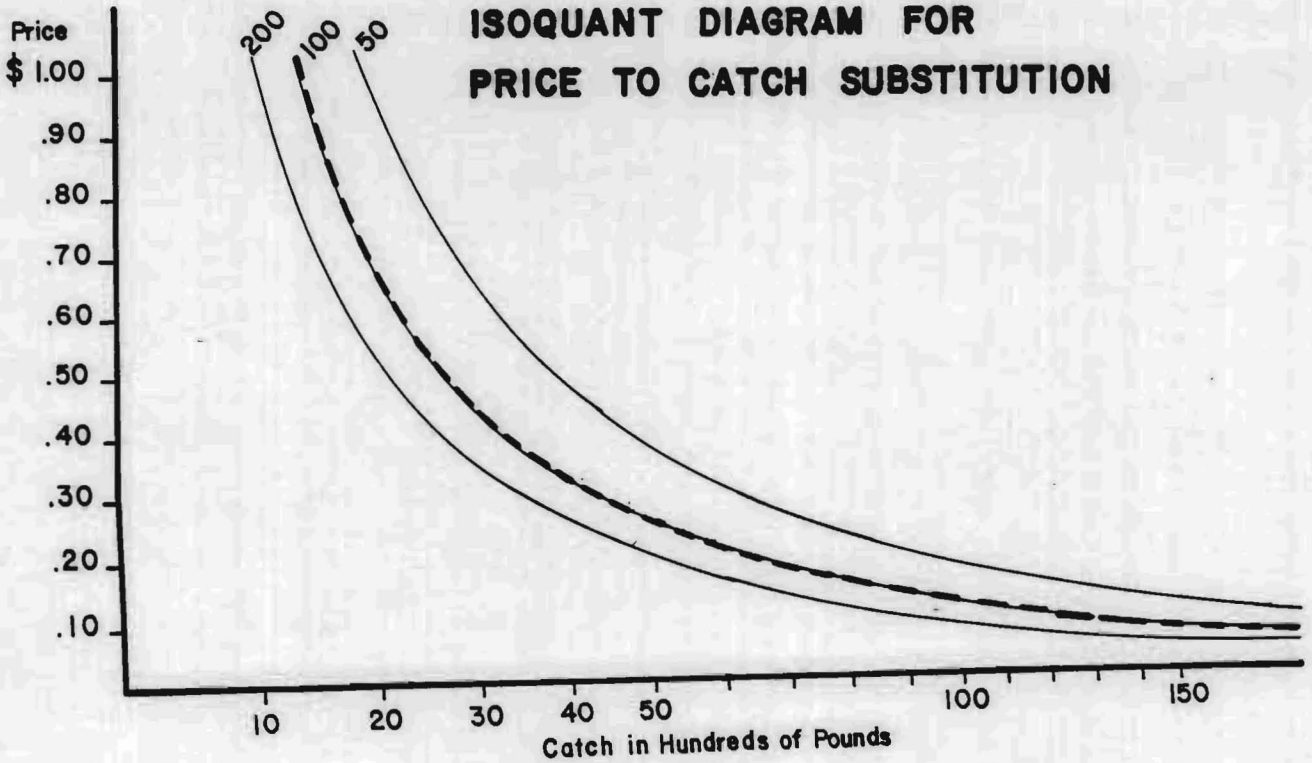
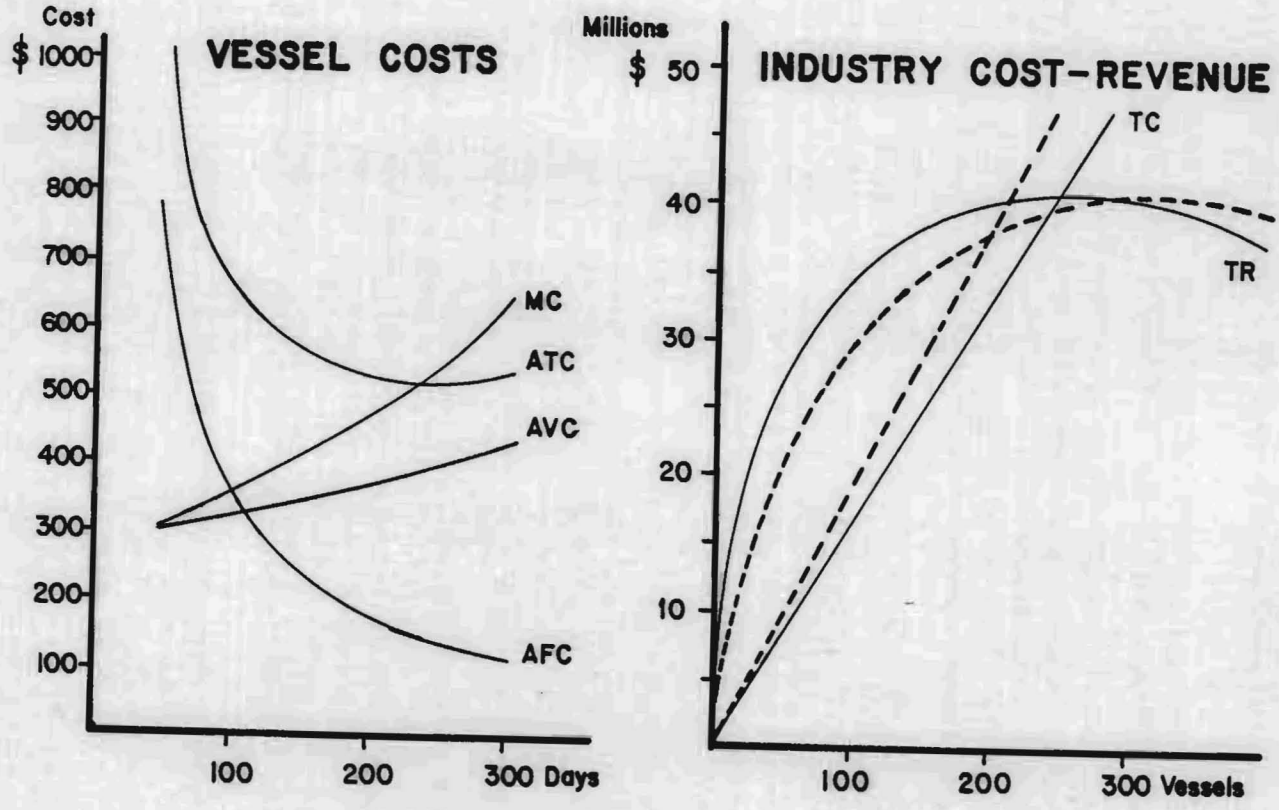
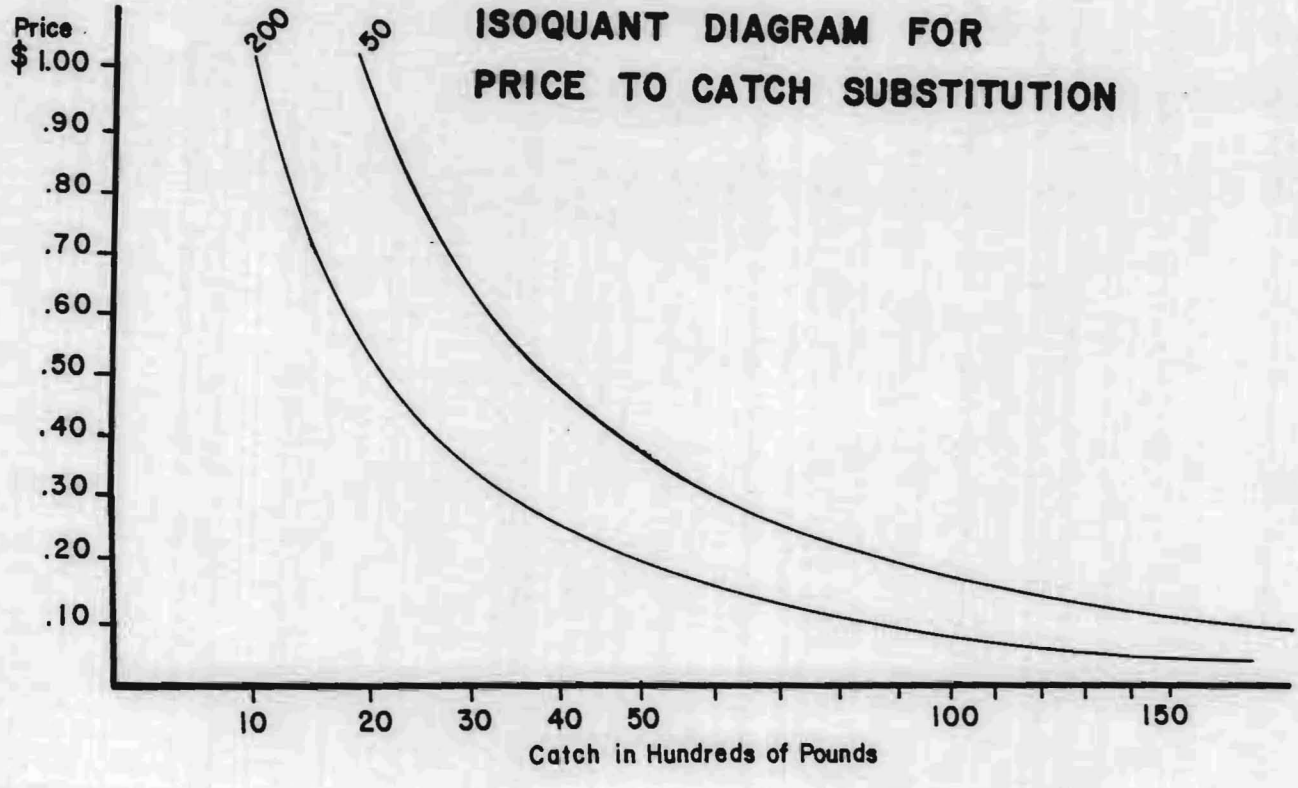


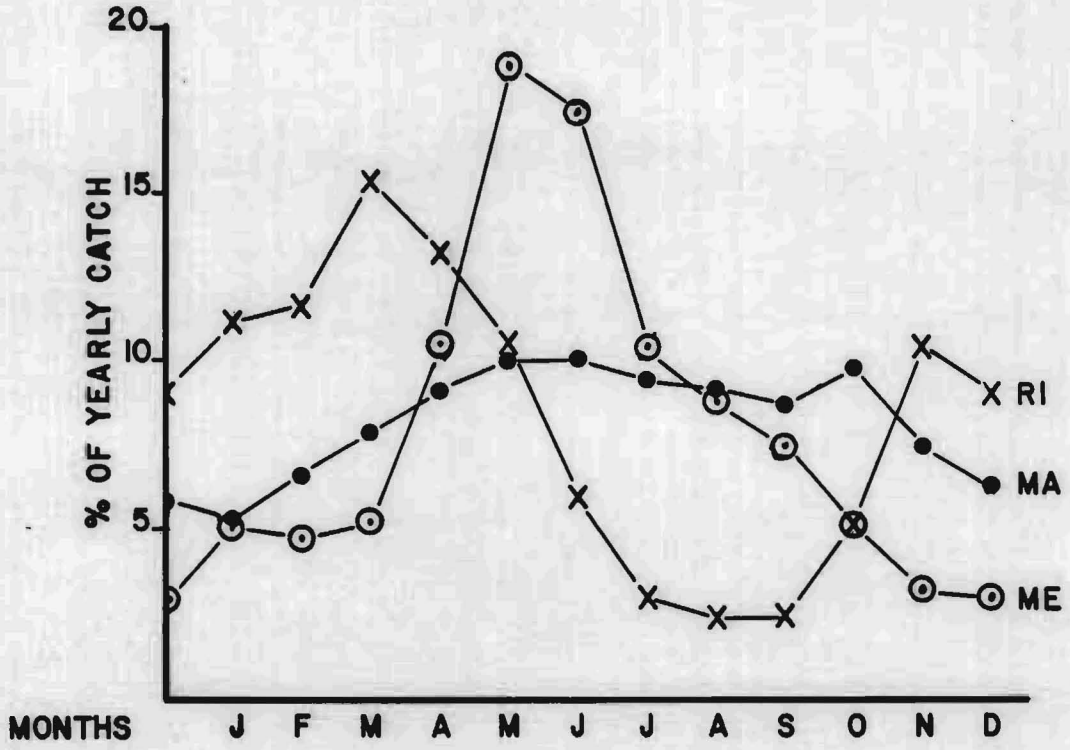
Figure 19

REGULATION BY CLOSED AREA





COD FISH CYCLES



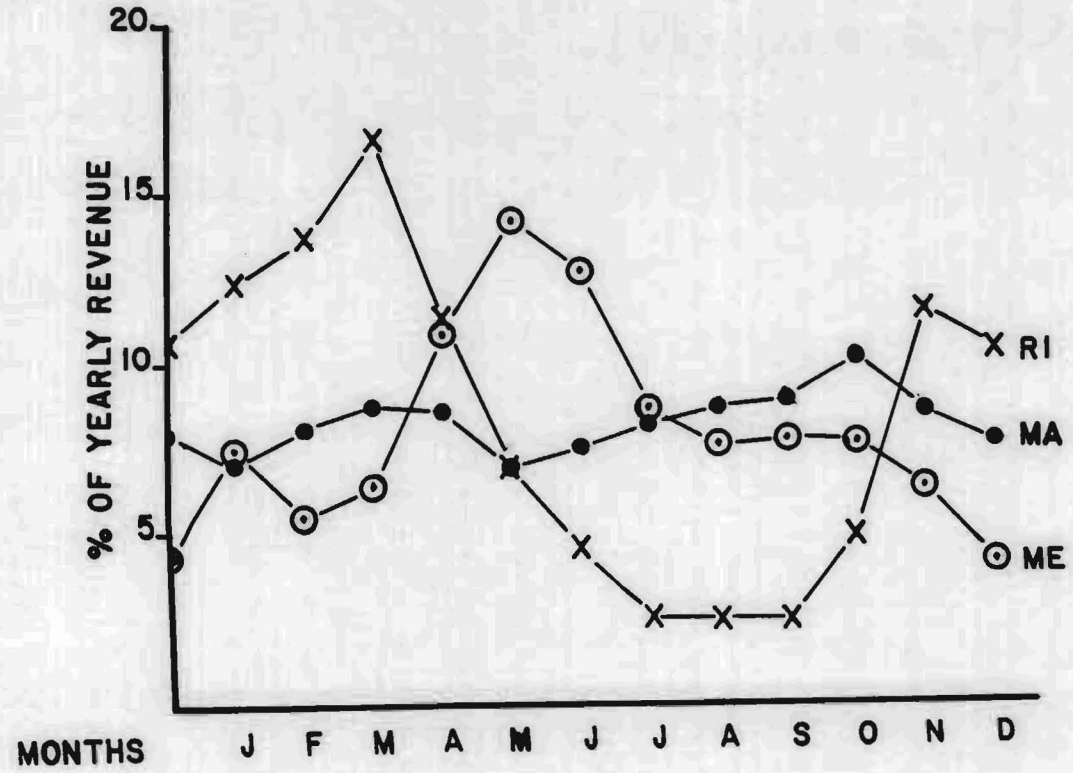
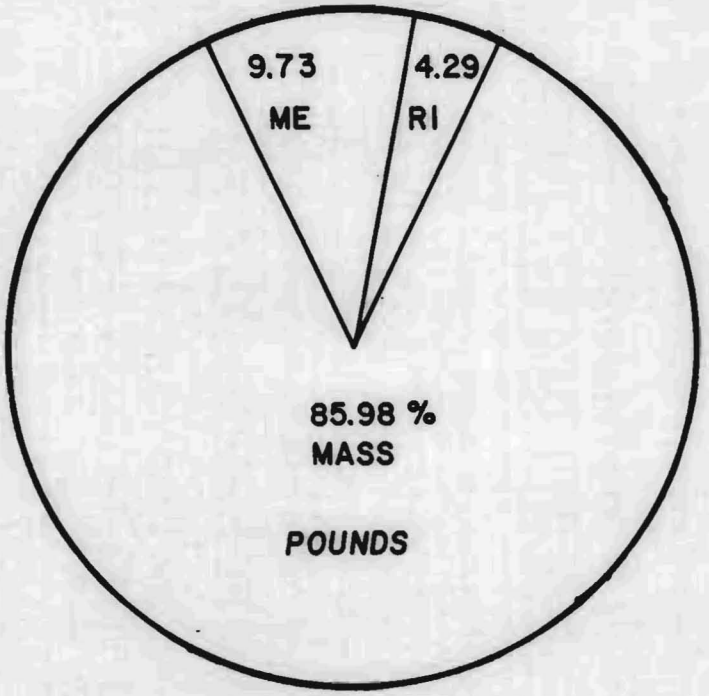
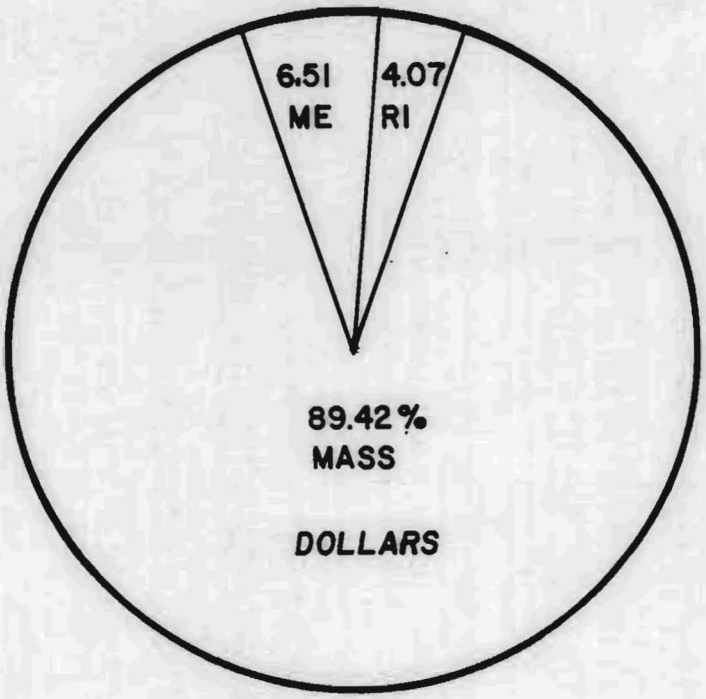


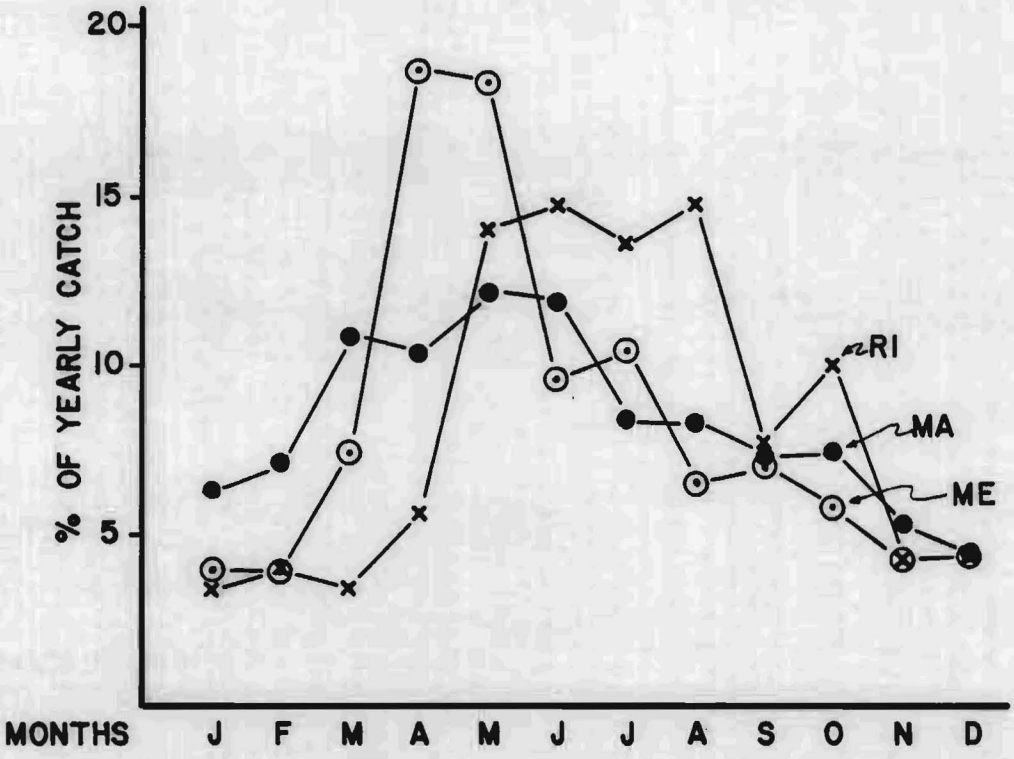
Figure 21

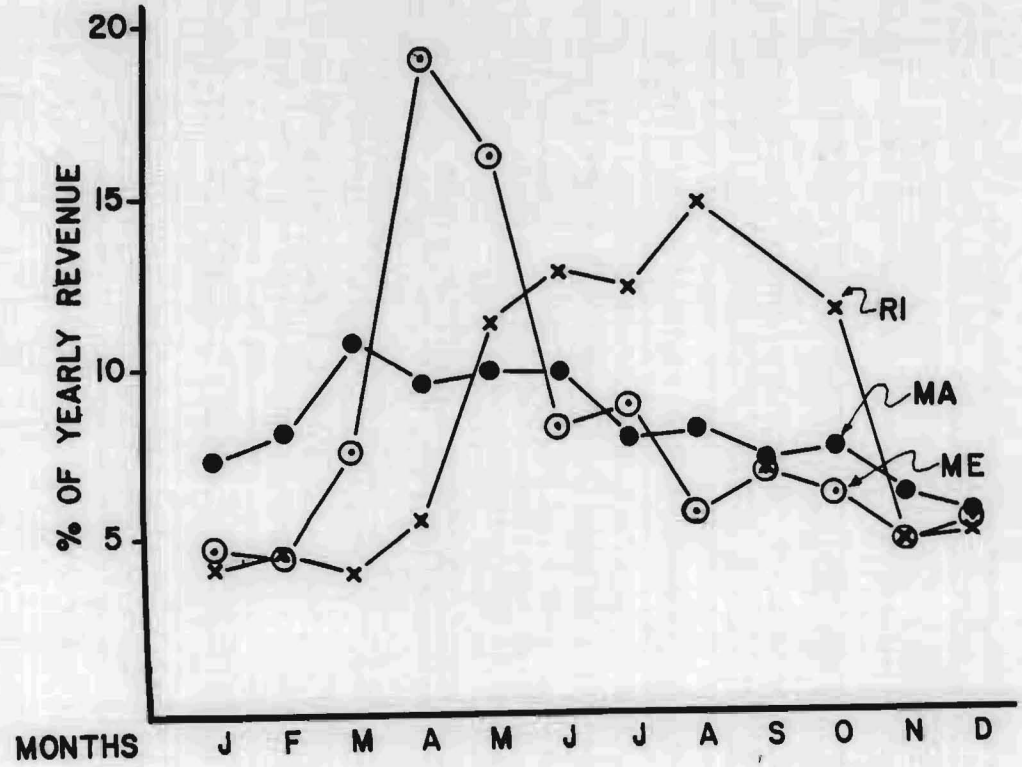
COD
MARKET SHARE BETWEEN
MASSACHUSETTS, MAINE, RHODE ISLAND



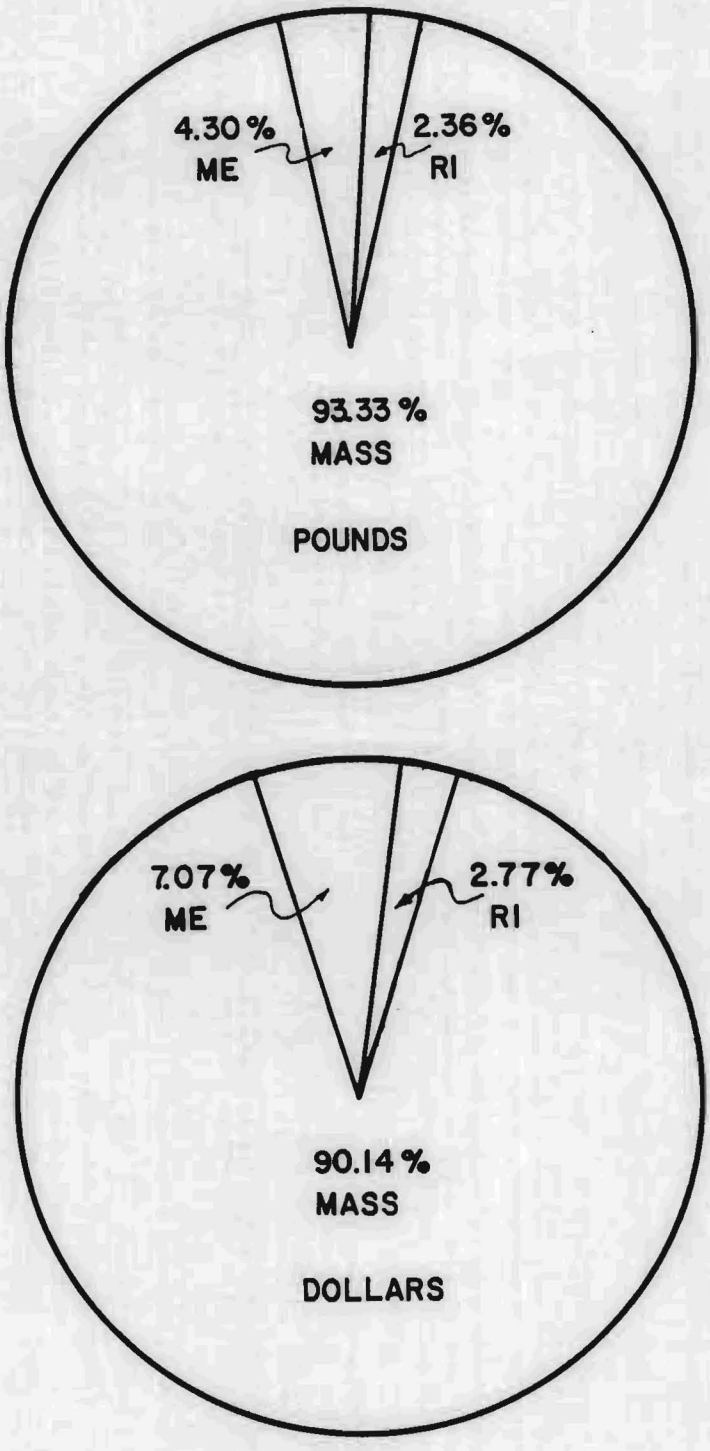


HADDOCK CYCLES

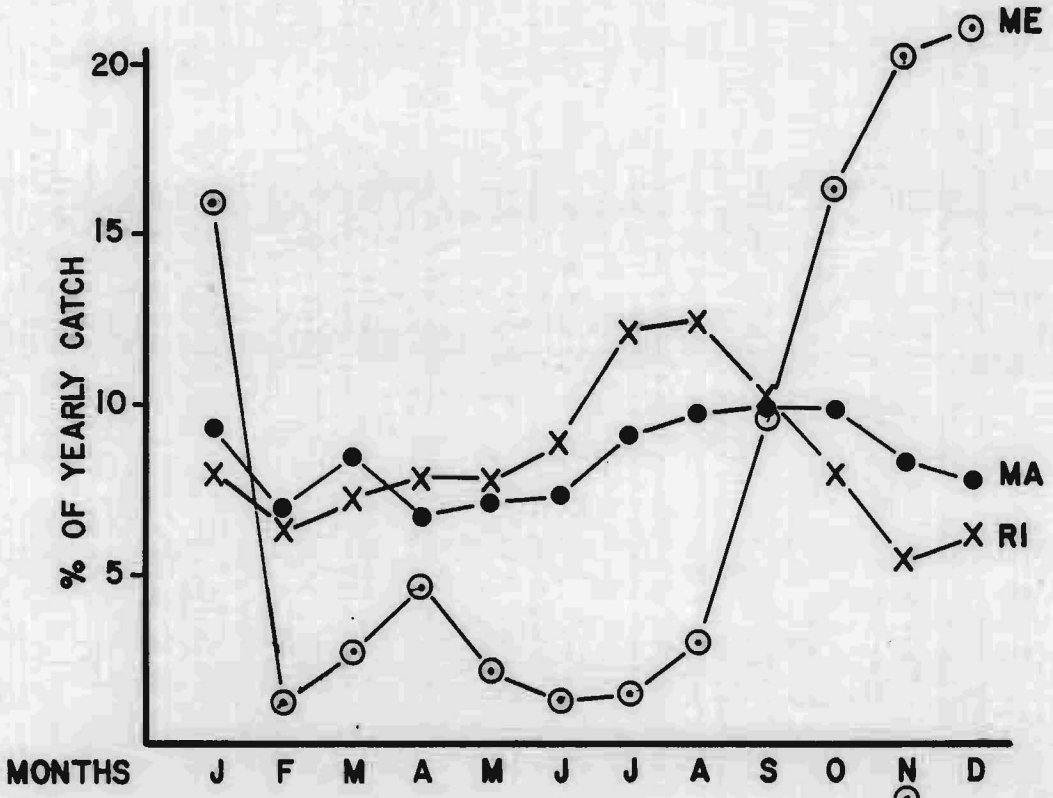


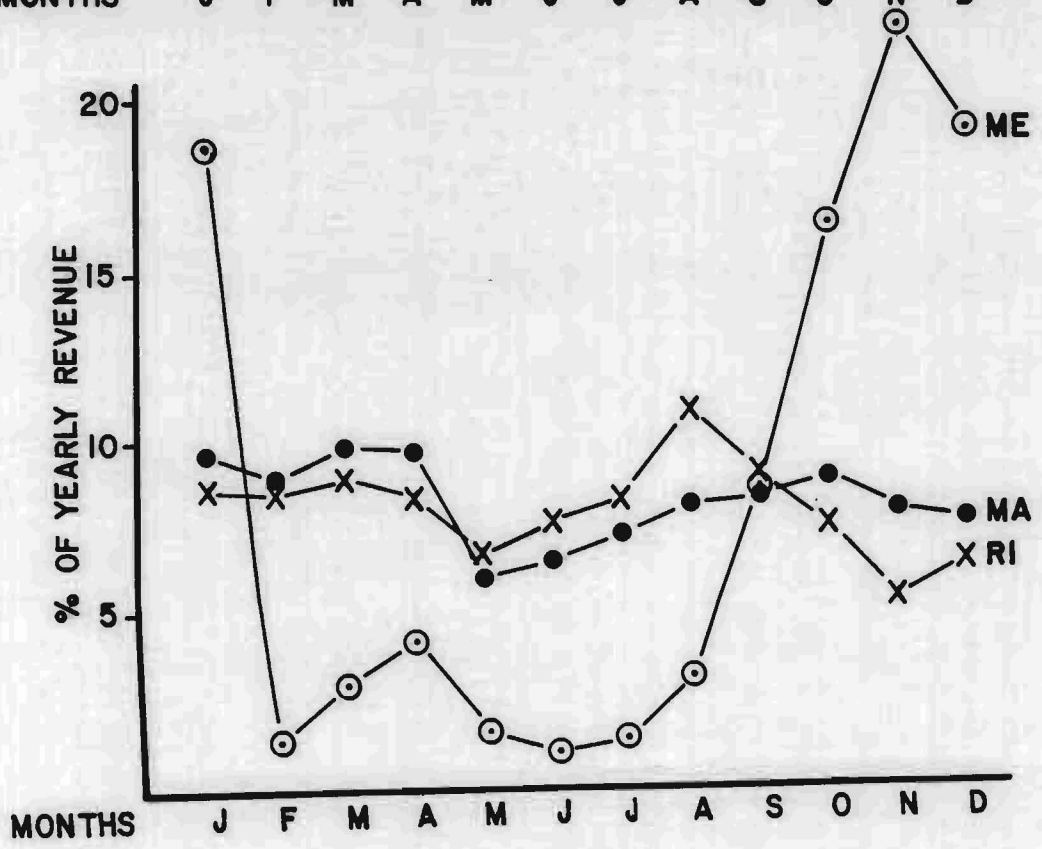


HADDOCK
MARKET SHARE BETWEEN MASSACHUSETTS, MAINE, RHODE ISLAND

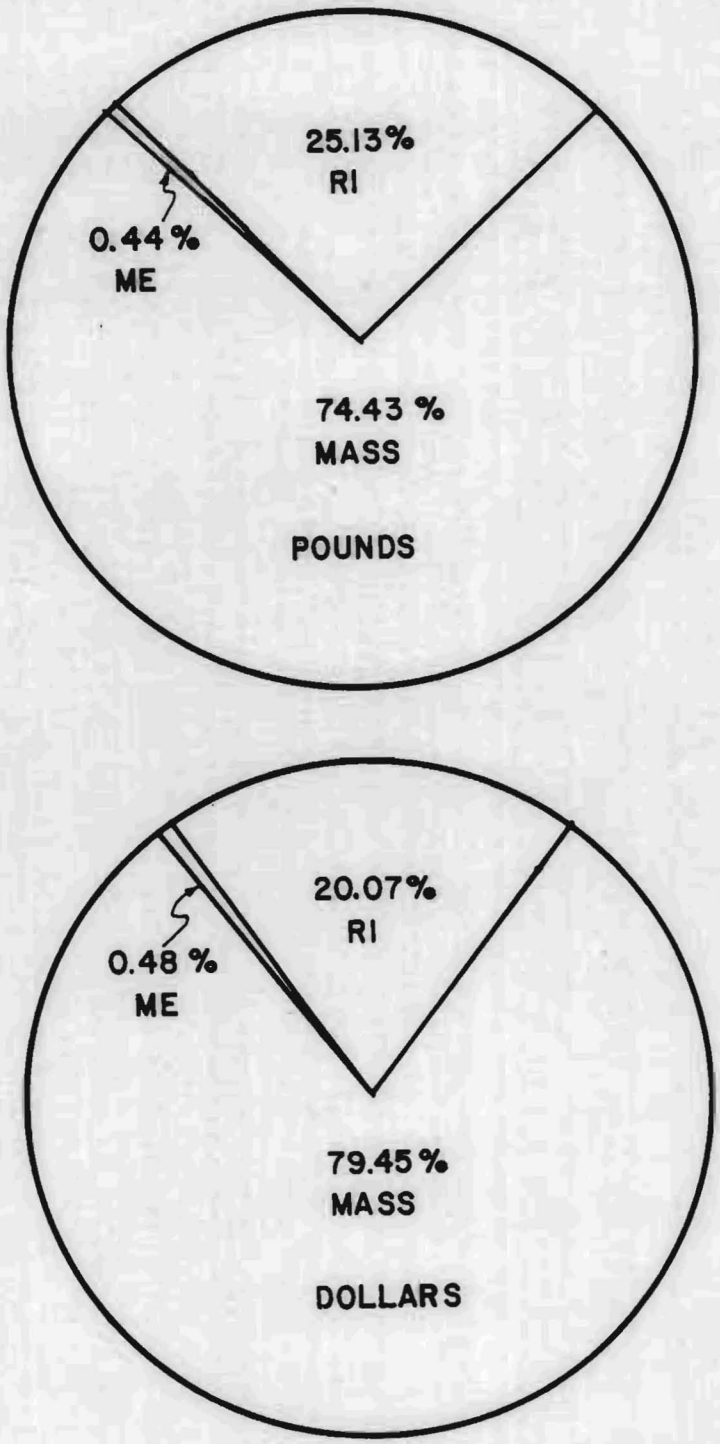


YELLOWTAIL CYCLES





YELLOWTAIL
MARKET SHARE BETWEEN MASSACHUSETTS, MAINE, RHODE ISLAND



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